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WHITE LIGHTS FOR SHIPS AND LIGHTHOUSES.

In the current Quarterly of the United States Naval Institute, Dr. John Herbert Claiborne, of New York, announces a very interesting theory concerning a system of lighting ships and lighthouses in substitution for the ones at present in use. Dr. Claiborne is of the opinion that color blindness and partial color blindness are much more prevalent than we imagine, and although the rules for the detection of this optical defect have been brought to a high point of efficiency, still, scientific men are fallible, and so are the rules which they enunciate.

The ordinarily refractive eye perceives objects within a distance of about twenty feet by rays of light which are approximately parallel. When objects nearer than twenty feet are looked at it becomes necessary to add some power to the refractive media, in order to see distinctly, since the rays of light that come to the eye from objects within that distance are divergent. The accommodative muscle of the eye automatically contracts, and the crystalline lens, which is elastic and resilient in its nature, springs forward. In this manner a positive meniscus is added to the eye, its strength varying directly with the nearness of the object looked at.

The rate of vibration of the waves arriving from a distant point has a peculiar effect on this accommodative muscle. The greater the accommodative act, the nearer the object appears. The long waves, such as the red rays, require more effort, and hence red appears nearest, while the blue, which has the shortest wave length, and therefore requires the least accommodative effort, appears farthest away.

Dr. Claiborne suggests that white electric light be utilized for signal lighting of both ships and lighthouses. In order to avoid confusion as to the port and starboard points aboard ship, he would place a series of lights in some geometric formation, such as a parallelogram for the port, and a star for the starboard indications. For the alternate flashing arc for lighthouses, or the alternate-color disc scheme of indication, he would substitute white electric lights arranged in some such geometric formation as would provide through its shape and size definite information concerning its position relative to a danger point.

Dr. Claiborne's suggestions are, of course, interesting, as they indicate a possible direction in which the electric light may find a further field of usefulness. His suggestions concerning color blindness and the difficulty of detecting it are of importance, however, in connection with any system of signaling, at sea or on land, in which luminous color signals are involved.

CENTRAL STATION COMPETITION WITH GAS POWER.

One of the most difficult classes of installation for the central station to displace with electricity is the gas-engine plant operated from city mains at a cost of from eighty cents per thousand cubic feet downward. In some communities the local gas companies have made a strong campaign for isolated-plant installations supplied from their mains, and the well-known efficiency of power production at full load in the modern gas engine is undoubtedly a telling argument with the consumer. With no boiler plant or producers to occupy valuable space, with steam piping and coal handling out of the way, the gas company finds it comparatively easy in many cases to secure the business, and not a few central station solicitors have had to wait sometimes a year or two before the operating results with the gas installation opened the way toward consideration of the substitution of electrical service.

In the isolated gas plant, however, more than the usual skill is demanded from the operating engineers, in comparison with steam-driven installations, to secure anything like permanent economy of power production. The quality of the gas may be kept close to the standard purity and heating value, but the problems of proper ignition, valve setting, cleanliness of moving parts and surfaces inside the engines, lubrication and water cooling are always present. If the isolated-plant owner does not realize the importance of having the best operating skill in his engine room, and at a cost commensurate with the ability of the men needed to keep the equipment in the very best condition, excessive depreciation is sure to set in, with ever-increasing breakdowns. The number of isolated-plant owners who neglect the condition of their plants in this way is very large, and the central station man who can directly or indirectly obtain any idea of the frequency of shutdown in such a plant has a strong basis for action in trying to secure a hearing for electric service.

In a recent case of this kind a factory making printing machinery installed a gas-engine equipment consisting of a forty-horse-power engine supplied with city gas, and another of the same size operated by a producer located on the premises. The cost of the gas ranged from eighty to sixty-five cents per thousand cubic feet, depending upon consumption. Power was transmitted through numerous belts and line shafts to the machines on the different floors, and to run the factory both engines were needed constantly. It was found that the cost of operation was greatly increased above the expected figures by the frequent failure of the engines to supply the necessary capacity continuously, the expense for repairs being considerable, but less important than the time lost by the factory force when no machinery was in operation. The local central station installed a thirty-five-horse-power motor on one floor and a ten-horse-power motor on another in place of the engines, with the result that the total monthly power bill barely exceeded the old labor cost in the power plant plus repairs. The results of tests with the motors showed that the actual working load in the factory under the new conditions is but forty to forty-five horse-power, whereas with the engine installation both machines were hard pressed to meet the ordinary daily demands.

In another instance, where an isolated gas plant of some 600 horse-power was installed with engineering skill at the owner's command, the cost of repairs has been found to be so high that it is only a question of time when central station service will succeed in displacing the present gas installation. In one recent month the cost of repairs to the engines was $1,500, and while the average is somewhat lower than this, the figures are not encouraging from the isolated-plant standpoint. The fact that several engines were installed has made it possible to keep up a reasonably continuous service even in face of the repairs required. The simplicity of electrical supply from the local central station organization, and the resulting freedom from shutdowns and repairs, will doubtless create notable savings in operation when the new equipment can be installed. The experience of most central stations is that unless the small private gas plant is operated with unusual skill, its costs are bound to be high enough in time to justify the substitution of electricity.

THE TELEPHONE IN MOUNTAINEERING.

Announcement of the completion of the Mount Rosa telephone line—the highest circuit in Europe—illustrates a new phase of telephone activity which should ultimately be productive of the most far-reaching good. The growing interest in high-mountain climbing during the past few years calls for the best resources of science and industry for the successful ascents of peaks in the less widely known of the great ranges of the world. The Mount Rosa line will greatly facilitate communication between the Regina Margherita Meteorological Observatory, at an altitude of 14,958 feet, and all the important telephone centres of Europe. The first section, just completed, from the observatory to the Col de Lys (11,962 feet above sea level and some two and one-half miles long) presented exceptional difficulties. Owing to the high winds and severe storms prevailing in these altitudes an overhead line carried on poles was out of the question, and it was thought that an insulated cable laid in the ground would make repairs impossible by gradually sinking into the ice. At the suggestion of Dr. Alessandri, chief of the physical observatories of Mount Rosa, who had been carrying on experiments as to the insulating qualities of dry snow in these regions, it was decided to lay a bare wire across the snow fields and glaciers. The wire has been laid for more than six weeks with no damage reported, and transmission is clear and distinct. From the Col de Lys downward the line will be carried on poles short enough to enable it to touch the ground and avoid oscillations. When completed the line will connect three observatories, and it will greatly improve communication at times when the meteorological conditions are unfavorable for visual signaling. The line will also be useful for sending messages to the valley as to the state of the weather on the mountain, preventing tourists from risking their lives on bad days, and also facilitating assistance from below in case of accident or other difficulties.

THE ACCIDENT ON THE BERLIN ELEVATED RAILROAD.

On September 26 a severe accident occurred on the electric elevated road of Berlin, Germany, in which twenty passengers were killed and as many severely injured, one of the latter, in fact, subsequently dying; and a score receiving lighter injuries.

A train from Möckern Bridge station to Bülow Street station collided at the famous triangle with one coming from Leipsig Place station to Bülow Street station, throwing the first car of the last train completely off the structure, the second being partially held in suspension over the edge.

This triangle has been studied by many of the foremost engineers, and this scheme of operation has been adopted in many electric traction systems; for instance, one will find the same principle in the City Hall loop and above the Ninety-sixth street station of the New York city subway. It consists of a double-tracked triangle in which the trains do not cross each other's tracks. However, when two or more trains running in the same direction try to make a switch simultaneously there is danger of collision, which apparently was the cause of the recent disaster.

The six tracks of this triangle change their elevation in crossing above or beneath the different legs. Inside of the triangle is a car barn and above the latter structure is a signal tower.

This triangle, as well as the whole elevated road, is well equipped with an interlocking signal system. The operator in the tower can not give a signal for a clear track until a train has passed a certain section of the track.

The movements of the trains entering the triangle are controlled by a group of three levers, which is interlocked with the group controlling the outgoing trains, so that when a single train passes the triangle six levers have to be operated. To facilitate operation these levers are operated by alternating-current motors supplied by a motor-generator set fed from the third rail. The trains may be run under a headway of two and one-half minutes.

The trains are made up of three or six cars. Under ordinary conditions three cars are run, consisting of two third-class cars, with a seating capacity of thirty-nine each, and one second-class car, with a seating capacity of forty-four, placed in the middle of the train. The third-class cars only are used as smokers and these are also the motor-cars. It was the first car (third class) containing the motorman and his assistant, which was thrown off the structure, while the middle or second-class car was held partially suspended.

The cars are built after American patterns, the seats running lengthwise. The side doors, however, are not near the end, but some distance away, so that there are seats on both sides of the doors. Under ordinary conditions the end doors are not open for public passage.

The Berlin Elevated Road has been in operation since February 15, 1902, and has had hardly any accidents, particularly on the triangle. Considering the efficacy of the system, it is difficult to explain how such an accident happened. A rigid investigation will probably show the fault, which can not be seen on the surface. Immediately after the accident the Government sealed up the signal system and took charge of the situation.

DEPRECIATION IN MUNICIPAL LIGHTING PLANTS.

Failure to provide proper allowance for depreciation has been the cause of no little embarrassment to municipal electric light plants in this country. One of the latest stations under municipal ownership to illustrate the importance of depreciation is the plant at Wakefield, Mass., which is in need of some $50,000 if it is to be brought up to date as a producing installation. In accordance with the laws of Massachusetts requiring a depreciation allowance of about three per cent to be set aside annually in municipal plants, the Wakefield plant has made such a provision for the last three or four years. Such an allowance, however, has not been adequate to overcome the deterioration of the plant, which has been going on for many years without suitable provision to offset it. At the last town meeting, on September 24, a special committee appointed to investigate the lighting conditions in the town reported against any further municipal operation of the generating station after power can be secured from the Malden Electric Company. It is figured that the cost of central station power to the town will be only three and one-quarter cents per kilowatt-hour, against its own cost last year of 4.6 cents, and only a trifling investment will be necessary on the part of the town.

Until municipal plants learn to provide for something more than mere operating expenses from the earliest days of service, their costs are bound to throw them more and more into the hands of the central stations, who are generally far better equipped to render satisfactory service for the same expenditure. The private company progressively operated has enough business sagacity to foresee the inevitable wear and tear upon the plant, and provides for it by setting aside from each year's income enough money to keep the apparatus up to date. The average city experimenting with municipal ownership is anxious to get all it can out of its plant; the citizens expect lower cost of service than private corporations charge, and the force of public opinion is in the direction of rather free accounting, except in those states where close control by commission is the order of the day. It takes all the plant's income to meet these demands. A common fallacy is to figure that the street lights cost the city nothing under municipal ownership, since the rates for commercial lighting and power are made high enough to bear the burden. It is easy for the municipality to allow the plant to go to pieces when the income is inadequate to permit suitable renewals. The cost of apparatus, also, is as a rule higher in the municipal plant than in the private central station of similar capacity. The Boston *Herald* has said, in commenting upon the Wakefield case: "The characteristic failure to apply to the administration of public enterprises the principles which are essential to private business circumscribes the field of practicable and profitable public ownership and operation in this country."

DETERMINATION OF WIRELESS WAVE FRONTS.

BY GREENLEAF W. PICKARD.

It has been assumed, from theoretical considerations, that wireless communication would be affected by the vicinity of

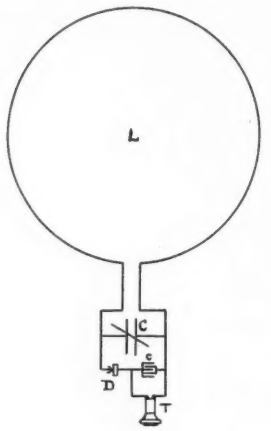

FIG. 1.—DIAGRAM OF CLOSED-CIRCUIT RECEIVING SYSTEM.

conducting structures, such as buildings, trees, etc. And it has been frequently observed in practice that a station in a city is not as effective as one on the seashore, where there are no energy-robbing obstacles in the path of the waves. It does not appear, however, that any one has determined just what the distortion

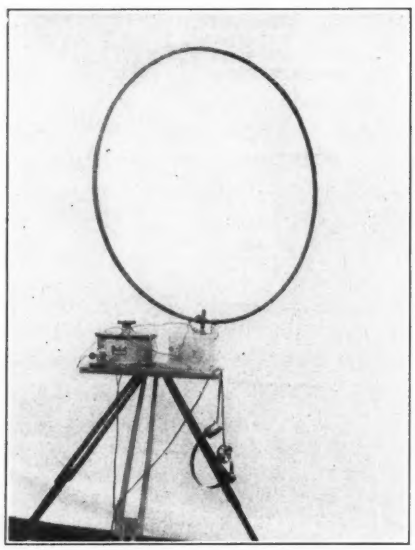

FIG. 2.—VIEW OF RECEIVING APPARATUS.

of the wave front really is, when this encounters buildings and other obstructions of a more or less conductive nature.

The writer has an experimental station in Amesbury, Mass., a town of about 10,000 inhabitants. As is usual in small towns, most of the buildings are wood, but there are many brick structures, the customary network of overhead wires, and a large number of shade trees, which might reasonably be expected to distort the waves used in wireless communication. Even a wooden house, transparent as the material may be to electrical waves, is usually lined with a system of well-grounded water and gas pipes, which gives the structure as a whole a conductive character. A series of wave-front determinations, made by means of the writer's underground receiving circuit,[1] showed clearly that such distortion existed and that the wave front in and about Amesbury was a very much warped surface indeed.

As determinations were only required at distances of a few wave lengths from the sending station, a very small closed circuit was employed, this being approximately one metre in diameter. This circuit consisted of three turns of No. 16 stranded copper wire, wound on a wooden hoop, its terminals being connected to a variable air condenser, and to a shunt circuit containing the writer's perikon[2] detector and a pair of high-resistance telephone receivers in multiple with a small fixed-value condenser. The circuit is shown diagrammatically in Fig. 1. It may be remarked that the use of three turns for the receiving circuit, in place of a single turn, is not for the purpose of gathering more energy from the waves, but merely to increase the inductance of the receiving circuit, in order that a conveniently small variable air condenser might be used for tuning.

For convenience in measurement and transportation, the entire apparatus was mounted on a tripod, the hoop being so mounted as to rotate freely on a vertical axis. The entire apparatus is shown in Fig. 2. Notwithstanding the small enclosed area of the circuit, it was found possible to receive intelligible signals at distances of over two miles from the sending station, and even to make determinations of wave-front direction.

The sending station was equipped with a three-wire aerial fan, 102 feet in height, connected by a simple autotransformer coupling with a closed oscillating circuit. In the closed oscillating circuit a glass condenser of 0.014 microfarad was used, charged to a potential of 20,000 volts. In all of the determinations the wave length used was 501 metres, and the power taken was 500 watts.

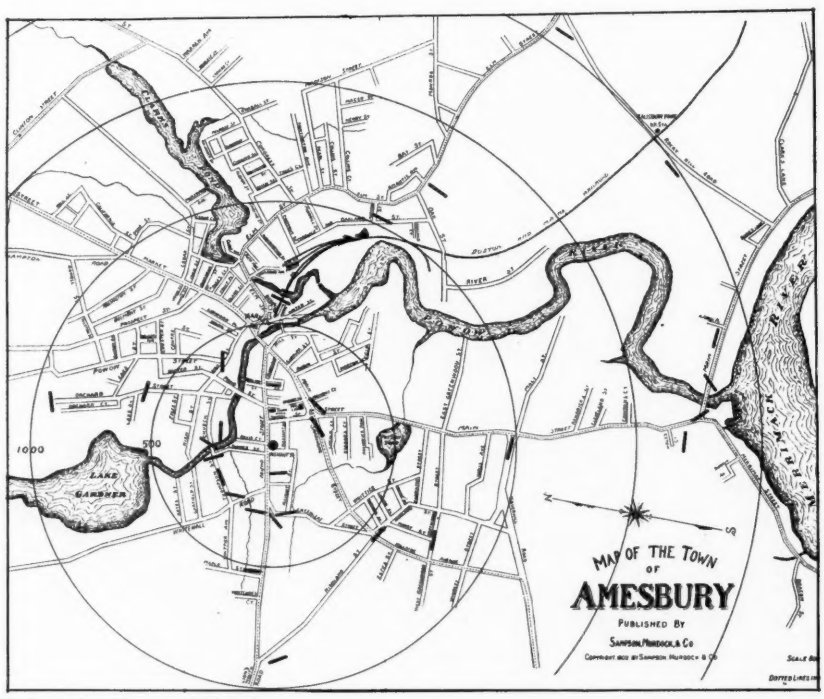

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FIG. 3.—RESULT OF WIRELESS SURVEY.

The result of the wireless survey of Amesbury is shown in Fig. 3. For convenience in estimating distances, concentric circles have been drawn about the sending station, at intervals of 500 metres, or very closely, one wave length. At each

[1] "An Ungrounded, Closed Circuit for Receiving Wireless Signals," ELECTRICAL REVIEW, June 15, 1907. U. S. Patent No. 876,996.

[2] U. S. Patent No. 886,154.

determination point the apparatus was set up, and the hoop rotated until a null point was found, at which the sound of the sparks at the transmitting station ceased in the receiving telephones. As the closed circuit is actuated by the magnetic lines of force in the electrical wave, this null point is necessarily when the hoop is in the plane of the wave front, in which position it is not threaded by the magnetic lines. It was found easily possible to locate this null point to within a degree of arc. In Fig. 3 each position at which a determination was made is shown by a heavy short line, this line being the projection of the hoop on the map, or in other words a section of the wave front at that point.

Had there been no distortion of the wave front these short lines would in every case have been tangent to a circle

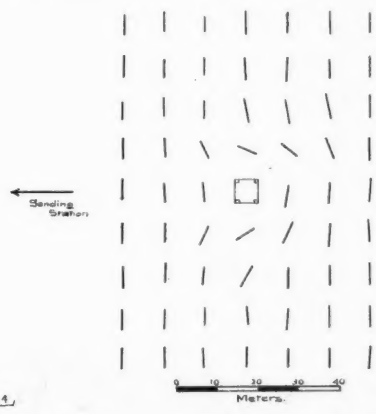


FIG. 4.—WAVE-FRONT DETERMINATION, SHOWING DISTORTION IN VICINITY OF OBSTRUCTING WINDMILL TOWER.

drawn through the point of observation on the sending station as a centre. While inspection of Fig. 3 will show several lines that are quite approximately so placed, it will at once be seen that the majority are by no means tangent; some, in fact, making angles of nearly ninety degrees with the theoretical undistorted wave front. As each such distorted portion of the wave means an eddy of lines of force around a conducting obstacle, with vertical electrical currents set up therein, it is evident that a considerable loss of energy is going on, to no other purpose than a slight heating of the obstacle.

Even such a high-resistance obstacle as a tree was found to make a perceptible eddy or indentation in the wave front,[1] while with a forty-foot steel windmill tower, distant some 1,500 metres from the sending station, a most marked distortion was found. This latter case was so interesting that the writer made a special study of the wave front in the vicinity of the tower, with the result shown in Fig. 4. It is hardly necessary to point out the resemblance to the well-known diagram of a current-carrying conductor in a magnetic field.

This simple method of mapping out the wave front in the vicinity of a wireless station is not only one of theoretical interest, but may have a practical application in determining, for example, why a station gives weak transmission in a certain direction. By the use of a larger closed circuit the survey could readily be extended to any desired distance from the sending station.

[1] In this connection it is interesting to note U. S. Patent No. 782,181, of G. O. Squier, for the use of trees as receiving antennæ

ILLUMINATING ENGINEERING SOCIETY.

SECOND ANNUAL CONVENTION TO BE HELD AT PHILADELPHIA, PA., OCTOBER 5 AND 6.

The second annual convention of the Illuminating Engineering Society will be held at Philadelphia, Pa., on Monday and Tuesday, October 5 and 6. The convention headquarters will be the Hotel Walton. Sessions will be held in the auditorium on the tenth floor of the hotel. An interesting exhibit of historical and scientific illuminating devices has been arranged adjacent to the convention room. Members will register at the assistant secretary's desk, convention floor, to obtain badges and cards for entertainment.

The following programme has been announced:

Monday, October 5, at 10.30 A. M.—Address of Welcome, Hon. John E. Reyburn, Mayor of Philadelphia. Presidential Address, Dr. Louis Bell—A study of the problem of street lighting in its broader aspects, especially with reference to the choice and placing of lamps in their relation to effective illumination. Report of Committee on Nomenclature and Standards, presented by Dr. A. C. Humphreys, president Stevens Institute.

On Monday, October 5, at 8 P. M., the following papers will be presented:

"Modern Gas Lighting Conveniences," by T. J. Little, Jr.

"Illuminating Value of Petroleum Oils," by Dr. A. H. Elliott.

"Street Lighting Fixtures: Gas and Electric," by H. Thurston Owens.

"Structural Difficulties in Installation Work," by James R. Strong.

"Architecture and Illumination," by Emile G. Perrott.

On Tuesday, October 6, at 9.30 A. M., the following papers will be presented:

"Intensity of Natural Illumination Throughout the Day," by Leonard J. Lewinson.

"The Integrating Sphere in Industrial Photometry," by Dr. Clayton H. Sharp and Preston S. Millar.

"The Ives Calorimeter in Illuminating Engineering," by Dr. Herbert E. Ives.

"Calculating and Comparing Lights from Various Sources," by Carl Hering.

"The Calculation of Illumination by the Flux of Light Method," by J. R. Cravath and V. R. Lansingh.

On Tuesday, October 6, at 2 P. M., these papers will be taken up:

"Street Lighting with Gas in Europe," by E. N. Wrightington.

"Design of the Illumination of the New York City Carnegie Libraries," by L. B. Marks.

"Engineering Problems in Illumination," by Alfred A. Wohlauer.

"Intrinsic Brightness of Lighting Sources," by J. E. Woodwell.

"Some Experiments on Reflection from Ceiling, Walls and Floor," by V. R. Lansingh and T. W. Rolph.

"The Relation Between Candle-Power and Voltage of Different Types of Incandescent Lamps," by Francis E. Cady.

Westinghouse Plan.

It was officially announced on September 28 that the bondholders' plan of reorganization of the Westinghouse Electric and Manufacturing Company, involving a foreclosure sale of the property, has been abandoned and in its place the so-called merchandise creditors' plan has been adopted.

It appears that the creditors' committee was unable to induce the stockholders to subscribe to the full quota of $6,000,000 of stock which was agreed upon last spring. There is, however, $4,500,000 of the new stock subscribed. The following official statement was issued recently by Joline, Larkin & Rathbone, counsel of the Jarvie committee, familiarly known as the Bondholders' Committee:

"The Readjustment Committee of the Westinghouse Electric and Manufacturing Company, of which James N. Jarvie is chairman, after a session lasting two days, adopted substantially the so-called merchandise creditors' plan, notwithstanding the fact that the cash subscriptions to the new assenting stock of $6,000,000 contemplated in such plan do not at this time exceed $4,500,000, and although the assent of a considerable amount of the bank debt and a portion of the merchandise debt still remains to be secured.

"This substitute or modified plan was adopted, however, with the distinct understanding that the plan will not be declared operative unless the full $6,000,000 of cash subscriptions and the assents of the bank creditors are in hand by October 27, 1908.

"The formal announcement of the plan and of its terms and conditions will be made the early part of next week."

THE FALK COMPANY'S PLANT.

THE FEATURES OF INTEREST OF A MODERN STEEL FOUNDRY AND MACHINE SHOP.

The Falk Company, of Milwaukee, Wis., operates the largest steel foundry and machine shop in the West. This plant has many features of special interest, particularly as concerns the economical arrangement and operation of the works.

The business of the Falk Company was started in an establishment devoted especially to the manufacture of street railway motor gears and track appliances. This department still constitutes an important division of the works, but the features of particular interest at this time are the foundry and power plant, the former a building 625 feet long and 295 feet wide at its largest part, having a capacity of 1,500 tons monthly. Steel castings of any size required up to forty tons capacity or more, and varying widely in character, are turned out.

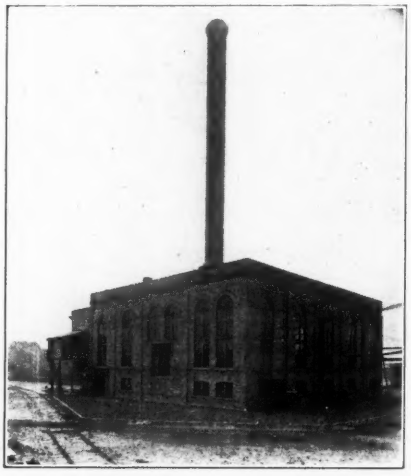
Pig iron is brought to the works over the Chicago, Milwaukee & St. Paul Railway, and left standing in cars on any one of the network of tracks which occupies a considerable portion of the company's ground. The cars are unloaded by means of a Cutler-Hammer two-ton lifting magnet at the end of a locomotive crane, and placed in piles between the tracks. An average analysis of each pile of pig iron or scrap is made, and the magnet is again called into play to load the iron directly into charging buckets carried on small industrial trucks. A record of the weight and contents of the buckets is then made, and the buckets are drawn up an incline to the charging floor of the furnaces. Charging machines feed the contents to one of two open-hearth furnaces, which are heated by oil fuel, which, after delivery in tank cars, is stored in three underground steel tanks, each with a capacity of 15,000 gallons.

The foundry is served throughout its length by eight traveling cranes built by Pawling & Harnischfeger, of Milwaukee.

The floor of the foundry is lighted in the daytime by side windows and a monitor extending the entire length of the building. At night arc-lamp illumination is used. The shops are heated in winter by means of the National Blower Company's system, which consists of forcing hot air through pipes running along the top of the building.

Unusually successful results have been obtained in this foundry by the use of electric welding. Bars welded by this method have stood tests of tensile strength up to 58,000 pounds per square inch.

The railway department of the Falk Company turns out cast-steel gears and forged-steel pinions, girder rail and high T-sections for city railways, low standard



POWER PLANT OF THE FALK COMPANY, MILWAUKEE, WIS.

sections of from fifty-six to 100 pounds for steam and interurban lines, and a great variety of special work. This department has an exceedingly well-equipped machine shop.

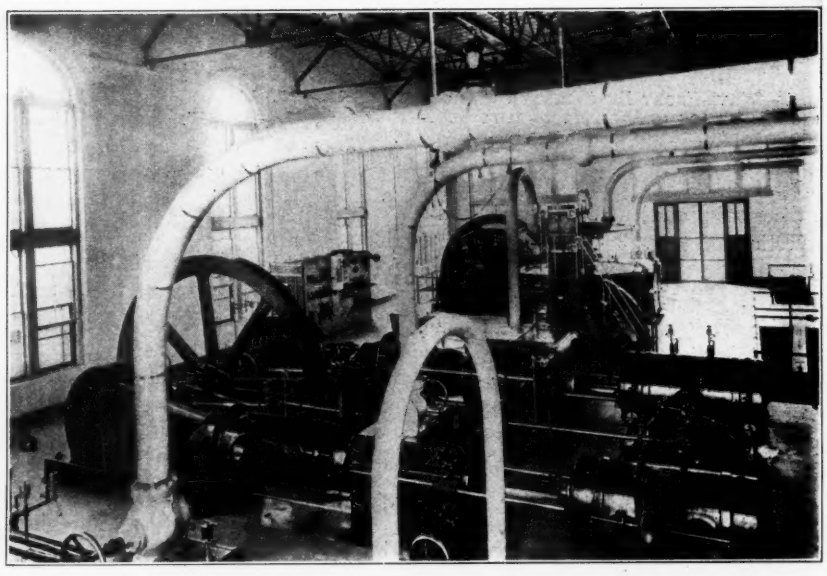
All of the work of the railway department is laid out and assembled before shipment. The laying out of the work is greatly facilitated by means of a special revolving crane of five tons' capacity.

All of the machinery in the entire works of the company which does not depend upon compressed air for its operation is electrically driven, principally by individual motors. In some instances short lines of shafting are used in such places as the pattern shop, cleaning department of the foundry, etc., where numbers of light-running machines make this arrangement most advantageous.

Electricity and compressed air are supplied from a new central power station, which is one of the most interesting features of the works. The equipment in all of its main details, including engines, generators, compressors, circulating pumps, etc., was furnished by the Allis-Chalmers Company, of Milwaukee, Wis.

The machinery consists of a cross-compound, condensing Reynolds-Corliss engine, twenty inches and forty-two inches by forty-two-inch stroke, operating at 100 revolutions per minute, and coupled to a 550-kilowatt, direct-current, 250-volt generator; an eighteen-inch and twenty-four-inch simple condensing Reynolds-Corliss engine of the vertical pattern, direct-connected to a 125-kilowatt, direct-current, 250-volt generator; and two air-compressors, one two-stage and the other single-stage, having capacities of 2,500 and 1,800 cubic feet of air per minute.

Lubrication is provided for the cylinders by sight-feed oil pumps and a gravity system. The oil flows after use to a five-chamber Turner filter, situated in the basement, and is pumped back to a 200-gallon tank located under the ceiling of the engine room.



ENGINE ROOM, FALK COMPANY, MILWAUKEE, WIS.

Three Wickes vertical water-tube boilers, designed for a working pressure of 150 pounds, and rated at 300 horse-power each, are located in the boiler room. These boilers are connected to a twelve-

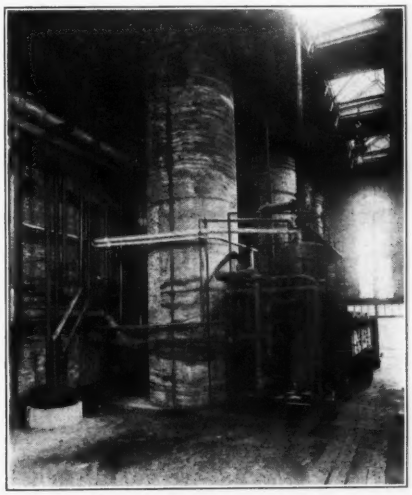
inch header, which divides into six-inch feeders serving the several engines. Steam is supplied at fifty pounds' pressure through large separators connected with Squire's traps.

All water for boiler feed is taken from the city mains, and first passed through the jackets and inter-coolers of the air-compressors before flowing to an open Crowley heater. Thence it is lifted to the boilers by one of two Burnham outside-packed plunger pumps of the Union Company's design, the second unit being used to work the turbine flue cleaner and for boiler washing.

Each furnace has independent dampers between it and the breeching, which connect with a reinforced concrete stack 180 feet high, having natural draft through an eight-foot flue. Each of the engines is connected to one of four Tomlinson barometric condensers built and installed by the Allis-Chalmers Company. The water flows from a nearby river to a deep well, where it is lifted to the condensers by means of steam-driven centrifugal pumps, one pump supplying two condensers.

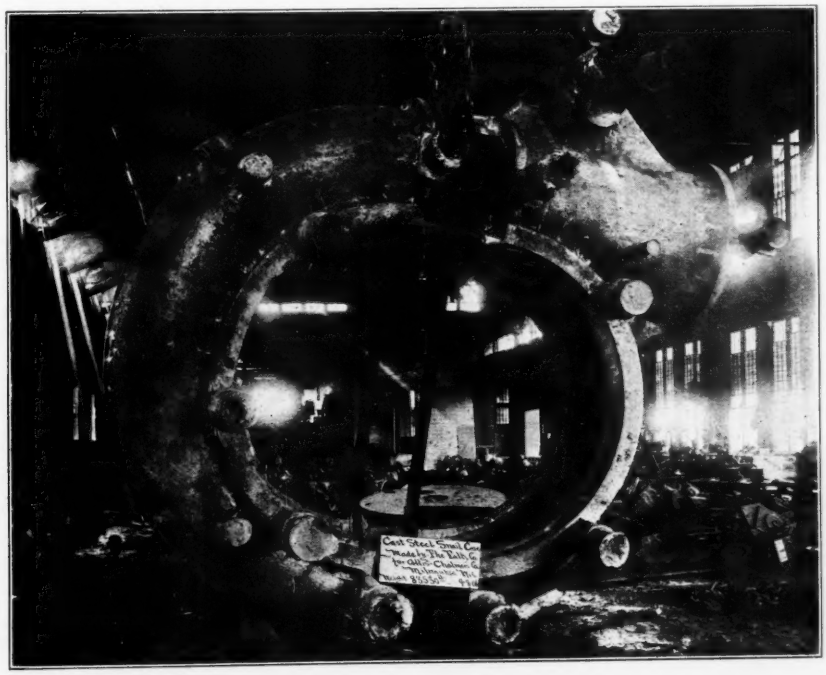
Coal is brought in on an inclined track and dumped over enclosed bunkers having a capacity of 400 tons, the cars being pulled by means of an electric hoist.

The switchboard was built by George F. Rohn, of Milwaukee, and is equipped with standard apparatus, including Cutler-Hammer switches. The distribution of current to the shops is through insulated underground cables, which feed a network of wires run in iron piping to the various departments where power is needed.



Boiler Room of the Falk Company, Milwaukee, Wis.

The plant is thoroughly equipped with modern appliances for conducting efficiency tests and gathering daily records, all of which are kept in constant service. This has had a very appreciable effect on the operating economy.



Cast Steel Snail Case, Made by the Falk Company for the Allis-Chalmers Company.

The company started in 1899 at its present site with a plant extending over less than a quarter of an acre. The present works have now an area of fifty acres, including a covered floor space of nearly ten acres. This rapid extension of the business is due to the efficient management of the works themselves, an interesting feature of which is the treatment of the employés and their relations to the officers and heads of departments. The company has demonstrated its ability to produce satisfactory castings, not only of a general character, but also those of the most difficult nature. In this way it has established itself with the largest and most particular users of steel castings in America.

The officers of the Falk Company are: Herman W. Falk, president; Otto H. Falk, vice-president; Charles L. Jones, second vice-president; E. A. Wurster, secretary and treasurer; Clarence R. Falk, works manager; Harold Falk, general superintendent; W. Frank Carr, chief engineer.

Annual Meeting of the Rejuvenated Sons of Jove.

The sixth annual meeting of the Order of the Rejuvenated Sons of Jove will be held at the Iroquois Hotel, Buffalo, N. Y., October 14, 15 and 16.

The meeting will open with a reception at 8 o'clock on Wednesday evening, October 14, at the Iroquois Hotel. At 10 P. M. there will be a special event for the entertainment of the Jovians.

At 9 A. M. on Thursday a trip will be made to the plant of the Roycrofters, at East Aurora, N. Y. At 10.30 A. M. an address will be made by Elbert Hubbard. At 12.15 o'clock luncheon will be served.

A business meeting will be held on Thursday at 2.30 P. M., at the Hotel Iroquois. Reports will be made by the auditing, financial and reorganization committees, and the officers of the sixth Jovian congress will report.

At 8 P. M. there will be an illuminated Jovian parade. At 9 P. M. there will be a grand rejuvenation at the cathedral of the Scottish Rite Masons. At 11 P. M. there will be a joviation, including a Dutch lunch, music, songs and speeches.

On Friday, October 15, a general meeting will be held at 10 A. M., when unfinished business will be taken up, and there will be a general discussion as to the needs of the order.

At 1 P. M. there will be a standing luncheon, and at 2.30 P. M. election and installation of officers.

The annual banquet will be held on Friday evening, at 7 o'clock.

Electrification of Steam Roads.

At the meeting of the Electric Club, of Chicago, Ill., on September 23, F. A. Sager, of the Arnold Company, delivered an address on "The Electrification of Steam Railroads."

"The railroads," he said, "will have to spend approximately $5,000,000,000 within a few years to keep up with the increase of traffic. By electrification at a cost of $4,000,000,000 they would increase their capacity to such an extent that no new trackage would be needed."

The meeting of the club was the first of a series which will be held for the purpose of throwing light on the electrification problem, and especially that of the Illinois Central suburban service.

In his address Mr. Sager took into consideration the work which had been done by the New York Central, the Baltimore & Ohio, the New York, New Haven & Hartford, the Erie and the New Jersey lines in the East, and at the St. Clair tunnel near Detroit.

The paper was followed by a general discussion in which the local situation was discussed, consideration being given to the difficulties which probably would be encountered, but the general opinion expressed was that the work offered no insurmountable obstacles.

"Electrification of the steam lines has been made slow chiefly for one reason," said Mr. Sager. "The men who have been trained by the old lines to high positions have a thorough knowledge of steam engineering, but little information as to electricity. On the other hand, the electrical engineers have been thoroughly trained in their specialty, but have not given their attention to the problems of the steam roads.

"The result is that the steam roads have had to call in electrical experts whose knowledge, as far as the old transportation went, was theoretical. They were unable to give past examples and experiences to add weight to their promises. But in practically every instance things have turned out, as to economy and efficiency, as the electricians said they would.

"It always has been thought that electricity could be applied with best results where the passenger traffic was large and broken up into frequent trains. Doubt was expressed as to the feasibility of applying electricity to the moving of freight. But the experiments have gone far enough to show that electricity far exceeds steam in economy and efficiency in three ways, as follows:

"At terminals where there are an unusual number of trains to handle. It is possible that legislators will come to realize this to such an extent that terminal electrification will be required by law.

"In mountain regions where there are heavy grades. Electricity will move trains more rapidly, with lessened cost of operation.

"At interior points where there is congestion due to large freight yards, junctions and unusual local traffic.

"It has been shown that electricity will very considerably reduce the cost of operation in suburban service. A very large economy has been shown in the eastern experiments, ranging from twelve to twenty-seven per cent. These savings were made when the initial expense of installation was still hanging on. As the extent of installation is increased the economy will be more marked.

"Necessity, however, will be the great factor in driving the roads to electrification. If money is still as hard for them to obtain when traffic starts to move again as it was a year ago, they will be driven to electrification in self-defense.

"It has been proved that the electric locomotive is forty per cent more efficient than the steam engine. It starts more quickly, moves more rapidly and will increase the capacity of switching yards on through tracks fully two-fifths. In other words, the installation of electricity would save millions and millions of dollars in new trackage and car equipment."

The Meeting of the Colorado Electric Light, Power and Railway Association.

The sixth annual meeting of the Colorado Electric Light, Power and Railway Association was held at Glenwood Springs, Col., September 16, 17 and 18. The first session was held at 4 o'clock, Wednesday, September 16, when a paper by S. E. Doane, chief engineer of the National Electric Lamp Association, was read. The next session was held at 8 o'clock Wednesday evening, when a paper entitled "The Operation of Hydroelectric and Steam Plants in Parallel" was read by J. C. Lawler, of Colorado Springs.

The third session was held at 10 o'clock Thursday morning, and papers were read by George Raymond Hall and John M. Mulvihill entitled, respectively, "The Electrification of Steam Railroads Operating in Mountainous Districts" and "The Popularizing of Public Utility Corporations by Careful, Painstaking Office Management."

The last session was held on Friday morning, when a paper by Clarence Renshaw, entitled "Some Notes on Single-Phase Railway Systems," was read.

The entertainment features of the meeting consisted of a trip on a special train on Friday afternoon to the works of the Central Colorado Power Company at Shoshone. The members made a thorough inspection of the dam, tunnels, building sites and tower construction.

On Thursday evening there was a rejuvenation of the Sons of Jove.

About thirty-five members and thirty-five associate members of the association were in attendance at the convention.

The following officers and committees were elected:

J. F. Dostal, Denver, Col., president.

W. T. Wallace, Cañon City, Col., vice-president.

J. C. Lawler, Colorado Springs, Col., secretary and treasurer.

Additional members of the executive committee—George B. Tripp, Colorado Springs, Col.; W. G. Matthews, Denver, Col.

Advisory committee—John A. Beeler, Denver, Col.; W. J. Barker, Denver, Col.; John F. Vail, Pueblo, Col.; C. K. Durbin, Denver, Col.; J. A. Cooper, Denver, Col.

Membership committee—L. M. Cargo, Denver, Col.; J. C. Davidson, Denver, Col.; C. H. Williams, Denver, Col.

Finance committee—Irving Hale, Denver, Col.; John A. Clay, Silverton, Col.; W. P. Eyre.

The Southern Idaho Irrigation Project.

J. G. White & Company, Incorporated, engineers and contractors, 43-49 Exchange Place, New York city, have commenced work on their contract to construct for the Idaho Irrigation Company, Limited, a complete irrigation system for about 150,000 acres of land situated in Southern Idaho. The water supply for this project will be obtained from Big Wood and Little Wood rivers. The lands to be irrigated are in the vicinity of Shoshone, Richfield and Gooding.

The irrigation system will consist of a storage dam, four diversion dams, four main channels, each leading to one of the tracts of land into which the project is divided and the complete system of distribution and drainage ditches necessary for the irrigation of these lands. The storage dam, which will form a reservoir of more than 150,000 acre-feet capacity, is to be built in the channel of Big Wood River in a lava cañon and is to be about 115 feet high, of rock-fill type with concrete core.

The diversion dams, two of which will be in the channel of Big Wood River and two in the channel of Little Wood River, are relatively small structures of sufficient height to raise the water to the level of the canals.

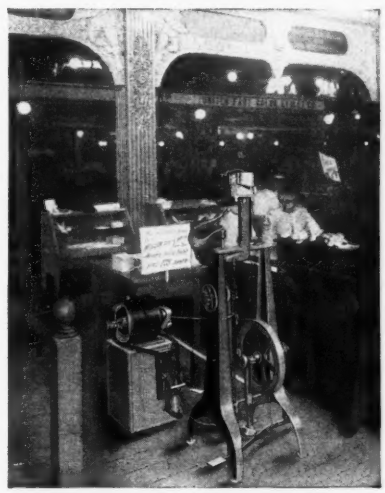
Electrical Machinery at a Shoe and Leather Exhibit.

The third annual National Shoe and Leather Market Fair, held at the Coliseum, Chicago, August 26 to September 2, was the most successful fair of its kind ever held. An idea of its size may be had from the fact that the huge Coliseum—the home of the Chicago Electrical Show—was completely filled with shoes, leather, machinery used in the shoe and leather industry and supplies. The decorations this year were even more elaborate than last year and, as they were uniform throughout, the effect was particularly pleasing. This applied not only to decoration but to the general arrangement of the booths as well. Each booth, being of a standard size and furnished throughout with mission furniture, gave each exhibitor an even chance to display his products.

Shoes were much in evidence of course, every kind from fine ladies' to men's high-top hunting boots being shown. This gave the retailer an opportunity to compare them side by side and get a line on the merits of each. To the average individual, however, this part of the display was not as interesting as the shoes in different stages of manufacture. Shoemaking and repairing machinery was shown in the Annex and it was here that the crowds lingered, watching some labor-saving machine do the work formerly done by hand. All these machines were driven by electric motors, both individual and group drive being used.

Booth of the Western Electric Company at the Shoe and Leather Fair.

Although the shoe and leather industry is a comparatively new field for electrical apparatus, great interest was shown by both exhibitors and visitors in the exhibit of the Western Electric Company. This company occupied a large booth in the Annex. Here both direct and alternating-current motors, arc lamps of various designs, exhaust and desk fans, and intercommunicating telephone sets were displayed. In addition to the motors shown in the Western Electric exhibit, Western Electric motors were seen in operation driving the shoemaking machines of other exhibitors. The arc lamps, too, on account of their brilliancy, brought a good many inquiries as to their adaptability to store and factory lighting and their superiority over the gas arc and



Bragg Automatic Shoe Nailer Driven by Western Electric Motor.

other forms of illuminants. This was particularly true of the Hawthorne "Short Arc" lamp, which, on account of its compact design—it being only twenty inches over all—met with general favor from those who, up to this time, had been unable to use arc lamps because their factories had low ceilings. The intercommunicating telephone sets for store and

Champion Shoe-Repairing Outfit Direct-Driven by Western Electric Motor.

factory use also came in for their share of attention from those interested in saving the time lost by the old walking-talking method of handling business. Many people were impressed with the advantages of an electric fan when they walked into the draft made by a sixteen-inch desk fan placed on a table near the aisle. The effect was particularly pleasing, however, for during the fair the Coliseum was uncomfortably warm and this booth was the one cool place in the building. Bulletins showing electrical apparatus designed especially for the shoe and leather market were distributed as well as general publications relating to lighting, power and telephone apparatus.

The Western Electric Company was very much in evidence throughout the fair and attracted quite a bit of favorable comment for its aggressive advertising. In the exhibits of four of the shoe-machinery companies whose machines were operated by Western Electric motors, namely, the Champion Shoe Machinery Company, the Puritan Manufacturing Company, J. E. Bragg & Company and the Dayton Last Works, were hung placards calling attention to the fact that the motors used were of Western Electric manufacture and that other electrical apparatus could be seen at the booth of the Western Electric Company in the Annex. This idea was further carried out by a placard hung in the Western Electric Company's booth explaining that Western Electric motors were in operation at the booths of these other companies.

A striking example of the efficacy of the moving exhibit was evidenced by the crowds which gathered around the booths where machinery in actual operation was exhibited. One of the best examples of this was the exhibit of the Champion Shoe Machinery Company. This exhibit showed a shoe-repairing outfit and harness-sewing machine. The repairing outfit consisted of a shoe stitcher, an edge trimmer, an edge cutter and a dust collector, all mounted on a common base and driven by a small, 110-volt Western Electric motor. The outfit was fitted with friction clutches which enabled the operator to put in operation any one part or the entire equipment at will, thus saving power and making this repairer a very economical machine. The dust collector is of much importance to the retailer because without it he would not be able to install his repairing outfit on the same floor with his shoe stock on account of the dust and dirt common to shoe repairing.

The entire equipment requires but one horse-power for its operation and runs at 500 revolutions per minute. The electric motor being a cheap, clean, reliable source of power, easily available at all times, is an ideal source of power here.

The Puritan Manufacturing Company also had an interesting exhibit of sewing machines. These were driven from a line shaft under the table on which the ma-

chines were mounted. A one-and-one-half-horse-power Western Electric direct-current motor was belted to this shaft and from the shaft a short belt ran up to each machine. This was an excellent example of group drive as applied to a number of similar machines.

The only moving sign at the fair was that in the booth of the Dayton Last Works. This sign, which was driven by a small direct-current Western Electric motor, was used to call attention to a line of shoe lasts known as the "Tread-strate."

J. E. Bragg & Company showed a new automatic nailing machine which, on account of the rapidity with which it operated, attracted a great many people to the booth of this company. This machine, known as the Crowe automatic shoe-nailing machine, is very simple in operation and at the same time very efficient. The nails are placed in a hopper and automatically fed down into a slot. The machine was driven by a small Western Electric direct-current motor similar to the one used by the Champion Shoe Machinery Company.

From every standpoint the fair was a success, as it brought together all the prominent shoe dealers and manufacturers and gave them an opportunity to study new methods of manufacture and see in actual operation the very latest labor-saving machines. The interest shown by the exhibitors and visitors at the fair in the electric motors and supplies showed that the shoe and leather field is one offering great opportunities to the manufacturer of electrical equipment.

To Discuss Railway Topics.

The executive committee of the National Association of Railway Commissioners has arranged for special addresses to be delivered at the meeting to be held at the rooms of the Interstate Commerce Commission in Washington, on October 6, as follows:

"Government Mediation in Railway Labor Disputes," by Martin A. Knapp, chairman Interstate Commerce Commission; "Regulation of Railway Capitalization," by Frank W. Stevens, chairman Public Service Commission, Second District, New York; "Car Efficiency," by Arthur Hale, chairman Committee on Car Efficiency of American Railway Association; "Uniform Rules Governing the Shipment and Carriage of Explosives and Other Articles Dangerous to Transport," by Dr. C. B. Dudley, president, and Colonel B. W. Dunn, chief inspector Bureau for the Safe Transportation of Explosives and Other Dangerous Articles.

Public Service Commissions.

At the recent meeting of the Vermont Electrical Association, in Bennington, Glenn Marston delivered an address on "Public Service Commissions," making some very interesting points, among which may be quoted the following:

"Every broad-minded person recognizes that in the main the interests of the public service corporations and the public are identical and that the object of a public service commission is to preserve this identity. A public service commission must protect the public and the corporations alike. The public is looking for the best possible service at the lowest possible rates; the corporation is looking for the most profitable business and realizes that it can only do its maximum amount of business by meeting to the fullest extent the wishes of the public. A public service commission should have the power to regulate rates, the quality of service, prevent competition, enforce satisfactory accounting and exercise a general supervision over the public utilities of the state.

"State regulation is far superior to any other method yet devised, because it removes the oversight of public utilities from local authorities. In the first place local regulation, and by that I mean either municipal ownership or municipal regulation of private companies, can not be provided by men familiar enough with the operation of the plants so regulated to make it trustworthy. The result is either an unfortunate laxity or a degree of municipal interference that sometimes goes so far as to put the company out of business.

"I want to emphasize the importance of a reasonable appeal to the courts from the decision of any commission which may be formed in this state. There should not be an unlimited appeal, because then a company might run to the courts at any time and tie up the decisions of the commission indefinitely. On the other hand, if no appeal is provided for, a corrupt or arbitrary commission would have powers which would put the companies absolutely at their mercy and the commission would not operate for the benefit of the public at large. It seems to me that the best way to provide for an appeal from the acts of the commission is to specify that the appeal shall be made within a certain time limit, say thirty days, and that it should be granted preference over all other cases in the court to which the appeal is taken.

"As to the duties of the commission, one of the most important is the enforcement of a uniform system of accounting, not only for the municipal plants but for the private companies. Municipal ownership has been consistently opposed by private companies for many years, not so much because the companies are opposed to municipal ownership in itself, but because they are opposed to the false and misleading accounts which are given out by the municipalities and which claim to show that the municipalities can manufacture electricity for less money than is possible under private ownership. A uniform system of accounting is just as valuable to the small company as to the large company—perhaps it is more so. I often hear the manager of a small company object to uniform accounting on the ground that his company can not make a good showing. That is the very reason why he should favor a commission which would enforce uniform accounting, because if it can be shown that his company does not operate profitably under the same accounting system as is used by the larger companies, he would be fully justified in going before the commission and asking that his rates be increased, so that he could operate at a reasonable profit.

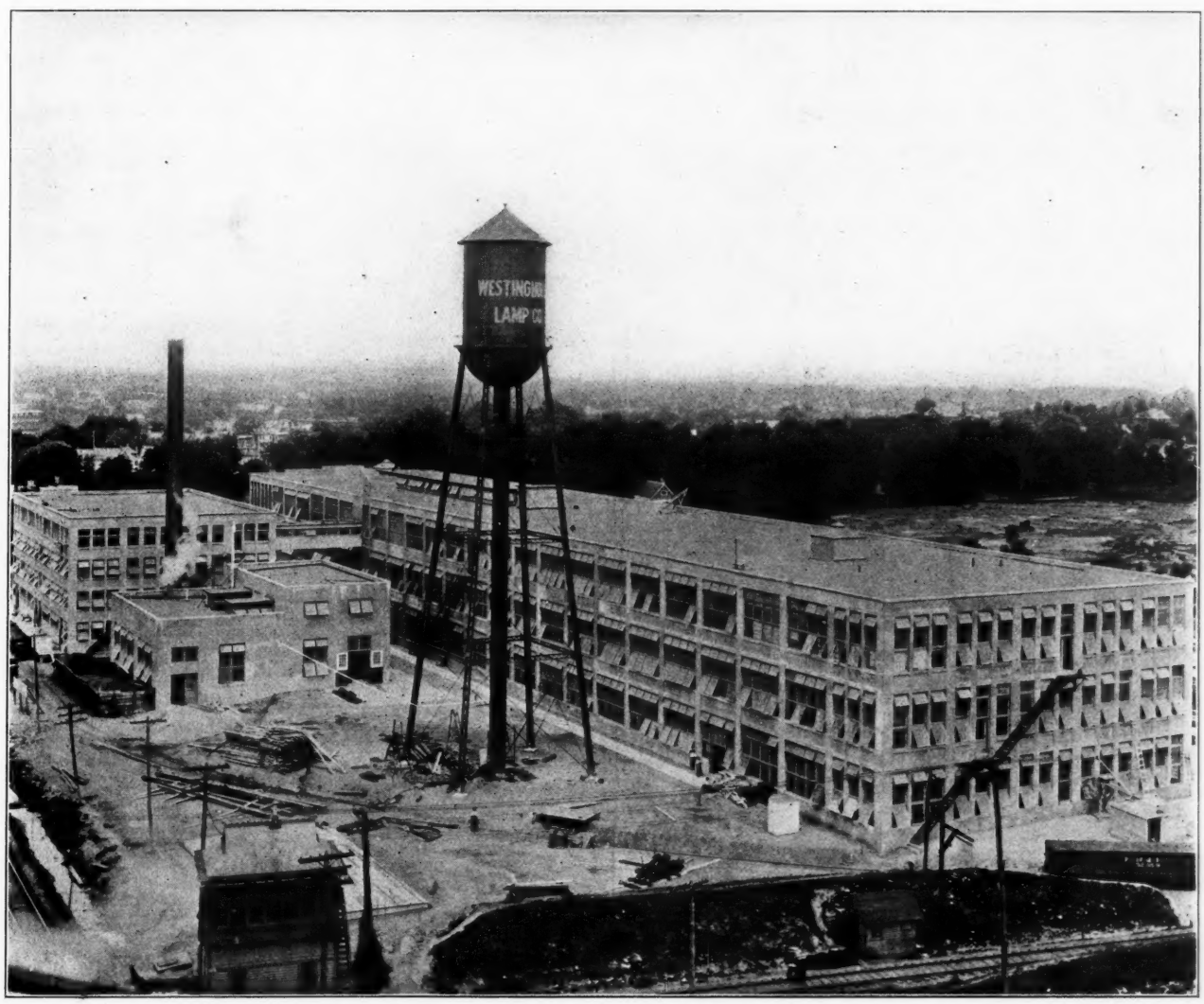
"State regulation makes municipal ownership unnecessary. It makes it unnecessary for a city to invest a large sum, when the money could be used for other purposes more advantageously. It makes competition unnecessary for it takes the place of competition. All that can be looked for from competition is a desire on the part of each competing company to give better service and lower rates than the other, in fact, the rates can not be at their lowest when there are two competing companies because fixed charges must be met on unnecessary duplicate equipment.

"You may say, 'Why not competition in this business the same as in the grocery business?' The answer is that the grocer does not have to make a huge initial investment in complicated machinery and equipment with which to serve his customers, but buys his manufactured commodity from the wholesaler and acts as a distributing agent only, while the lighting company has to spend thousands of dollars before it can secure a single customer. It is the huge wastefulness of competition in public utilities that makes some other form of public regulation necessary, and it is only through the most generous co-operation of the public and the company that the lighting business can be made to attain its greatest usefulness and become the standard of enlightened business progress before the world."

A Modern Lamp-Making Works.

The New Factory of the Westinghouse Lamp Company at Watsessing, N. J.

WHAT do good light, pure air and pleasant surroundings mean to an employé? Whatever the answer may be, they mean just the same thing to the manufacturing business itself. These and the continuity of operations in lamp manufacture are what the architects and engineers had in mind when they designed and constructed the works of the Westinghouse Lamp Company at Watsessing, N. J. A visitor to the works is struck by the unusually favorable condition under which the employés work. Tidiness is noticeable in every department. There is no crowding of employés; no foul air to make them drowsy and inefficient long before the day is done. High ceilings and plenty of windows make it possible for all to work in rooms always filled with a plentiful supply of pure air. Although these new works of the company have been operating but a few months the reports of output in quantity and quality of the product stand as conclusive evidence that an employé will do more work and better work if placed amid surroundings that are healthful and inspiring.



General View of Factory and Grounds of the Westinghouse Lamp Company, at Watsessing, N. J.

The plant, which occupies a level site comprising fifteen acres of land, consists essentially of three structures—main manufacturing building, 521 by 100 feet, three stories high, with a floor-to-floor height of seventeen feet four inches; storehouse, 140 by eighty feet, four stories high, and power-house, eighty-three by sixty-six feet. The foundations of the buildings have been made of sufficient strength to permit the addition of one or more stories when desirable.

All buildings are designed to be as nearly fireproof as possible, being constructed throughout of reinforced concrete.

Lighting and heating are supplied from a central power plant, which furnishes current for elevators, pumps, fans and for manufacturing operations.

The power-house is directly back of the storage house and is designed to contain 1,000 horse-power of Stirling boilers. The following installation furnishes the necessary power for the operation of the works at the present time:

One 250-kilowatt, alternating-current, direct-connected Westinghouse unit, with one twenty-five-kilowatt exciter; one fifty-

kilowatt, alternating-current, direct-connected Westinghouse unit, with ten-kilowatt exciter; one ninety-kilowatt belt-driven generator; one forty-horse-power Westinghouse motor-generator set to supply direct current; one steam-driven air-compressor supplying air at from three to five pounds pressure for blow-pipe work; one motor-driven air-compressor, belt-connected, to supply air at 100 pounds pressure for distribution through the manufacturing building.

As a part of the power equipment, although placed in the manufacturing building, in the south end of the first floor, electrically driven, are seventeen vacuum pumps.

All mechanical processes are operated by electric drive, and the latest and best appliances used in lamp manufacture have been secured. Many of the machines used in these new works have been developed by the company's engineers and the company has built the machines at the works.

The buildings are heated by indirect radiation, large stands of heating stacks being provided on the ground floor, through which the outside air is drawn by electrically driven fans and distributed in galvanized-iron ducts through all parts of the buildings. Hot water is circulated through the heating stacks by an electrically driven centrifugal pump located in the boiler room of the power-house, where the water is heated by exhaust steam.

Special attention has been given to the matter of fire protection, and the entire plant is equipped with automatic sprinklers, which are supplied with water from a steel tank of 100,000 gallons capacity placed on a tower 100 feet high. Further fire protection is provided by a system of underground piping in the yard connecting with fire hydrants. This system is fed by a 1,500-gallon Underwriters' fire pump, which draws its water from an underground reservoir of 200,000 gallons capacity. A reserve water supply is secured by connection with the regular water service system of the town of Bloomfield, N. J.

Fire-escapes are located on three sides of the main building, and one on the storage house. All stairways in the building are constructed entirely of cement and iron, so that these may be relied upon as safe exits in case of fire. On every floor the stairways are separated from the working sections by fire doors.

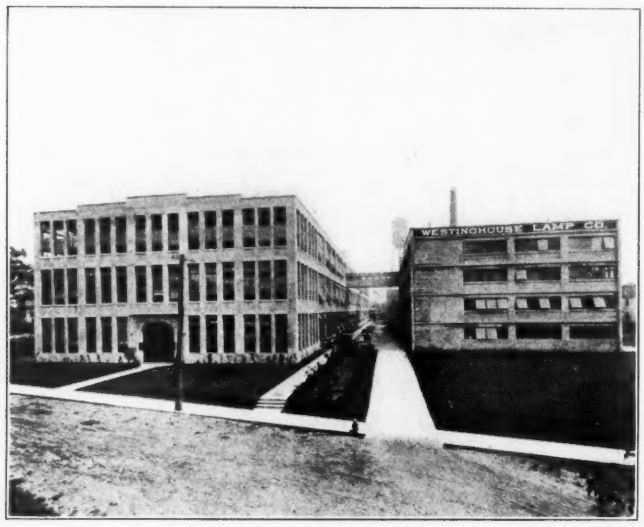
A volunteer fire department is organized among the employés, and there are stations on every floor with a full equipment of fire-fighting apparatus, including hand chemical extinguishers, fire buckets, axes, hose, etc. These stations are clearly indicated by red lights. The fire department has a further equipment of a chemical wagon, with a capacity of ten gallons.

In the manufacturing building all rooms are made especially, light, large and airy, and are finished in light gray. Toilet accommodations, carefully designed and equipped with a view to health and comfort, are provided at convenient points on all floors.

Drinking water is furnished on all floors at convenient intervals, from a well drilled to a depth of 550 feet on the company's property. This well supplies all the water needed for manufacturing purposes and fire protection.

The storage house is the first building to be seen, coming from the railroad station. It was purposely placed adjoining the tracks of the Delaware, Lackawanna & Western Railroad and the Erie Railroad to facilitate the loading and unloading of material.

In the storage house are received and stored all the raw materials required in lamp manufacture. Starting at the storage house and ending in the same building is the best system of shop routine known to the art of lamp making. There is no back action to impede the work and every step is in one forward direction. There is interwoven with the manufactur-



View of Main Building and Storage Building, and Interior View of Factory Floor Before Occupancy, Westinghouse Lamp Company Factory, Watsessing, N. J.

ing process so closely as to be part and parcel of it, a system of inspection and accounting, by means of which every important operation is inspected and approved by an expert before it is permitted to pass on to the next operation. A space on each floor of the main building nearest the storage house, about thirty feet wide and running almost its entire length, is reserved for the stores and inspection department.

It will be seen at a glance that this means to the customer a very high grade of product, and at the same time effects a tremendous saving to the manufacturer in preventing further operation on pieces once found defective.

It also makes it possible to operate the factory on the premium piecework system. Careful record being kept of the grade of work turned out by each operative, the inspector once a month is able to prepare for the management a statement showing clearly the quantity and grade of work turned out by each employé, as well as

the standing of one employé with another in the same class of operation.

The process of making the filament begins on the first floor of the main building. Here the filament undergoes fourteen operations, beginning with the preparation for the brew, the squirting into fibre, its washing, and later the winding of the fibre on drums which are electrically driven, each drum having one attendant to feed the fibre. Other operations include the forming of the filament on frames, then the packing, first for the preliminary furnaces and later for the final furnaces, then the sizing, cutting and counting. The counting, which is done by weight, is most interesting to the visitor, who is naturally surprised to learn that this method of counting is correct within two per cent, and is far more accurate than counting by hand.

The treating of the filament takes place on the second floor at the south end of the main building. Here there are four long treating tables, each providing room for eight operatives. Each operative has facilities for treating simultaneously four filaments in separate chambers of hydrocarbon gas. After this, inspection is made as to the length and cross-section of the filament, and check inspection is also made for resistance, shape, etc.

Reference should next be made to the process necessary to make the stem through which the leading-in wires are inserted before being sealed in the glass bulb. Glass in long tubes is cut into short lengths and fed into what are known as flanging machines. In point of economy of operation these are most interesting, being entirely automatic and requiring but one attendant to keep them filled and in adjustment. The hoppers at the top of the machines are kept filled with these short lengths, which, as they pass through the apparatus are heated on one end by gas flame and mechanically flanged.

After the insertion of the platinum-tipped leading-in wires, the anchor wire and the forming of the seal by an automatic clamping attachment which is a part of the stem-making machine, the finished stems pass through an inspection and stores department to long tables for the mounting of the filament. Here the stems are arranged in frames and the filament attached preparatory to the straightening of the leading-in and anchor wires.

Lamp Basing Department, New Factory of Westinghouse Lamp Company, Watsessing, N. J.

From this point the mounted stems, containing the leading-in wires, anchor wires and filament are passed through an inspection department to the sealing-in machines. However, we should now give some attention to the glass bulbs which, after having been washed and placed in the stores and inspection department, are taken to the tubulating machines, where by means of a needle gas-flame a tube is welded to the end of the bulb, which later provides a connection through which the lamp is exhausted. A large number of special tubulating machines are arranged

on tables and there is one operator to each machine.

At the sealing-in machines the bulbs which have been tubulated meet the finished stems whereon the filaments have been mounted. These machines are equipped with holders for both the bulbs and stems, which are brought together in the proper position by the operator, and by mechanically rotating in an eight-flame gas blast the steam is sealed in the bulb, the joint being air-tight.

The special machines which are used for creating the vacuum in the bulb are provided with two-cylinder exhaust or vacuum pumps. Each operator has two lamps on the machine at once so that no time is lost during the process, as while one lamp is being subjected to the action of the exhaust pumps the other is being sealed off, that is, the tube which has been attached to the bulb in the tubulating process and through which the exhaust pump is drawing on the bulb, is fired off by hand into a symmetrical tip.

The bulbs which have been sealed in and exhausted pass through the stores and inspection department for examination and counting and then go down to the second floor for photometering. Here a force of experts test the lamps in darkened rooms to determine the rating, which is marked on the bulb in each case. From here the lamps pass to the first floor, where they meet the bases and where by means of rotating machines in which the bulbs are placed the bases are affixed and soldered by gas fire.

Such of the lamps as are packed for immediate shipment pass over to the shipping room. Stock lamps are carried to the upper floors of the storage house and held subject to order.

A special branch of manufacture not yet mentioned is the tungsten lamp manufacturing department, which occupies most of the second floor in the main building of the works and is devoted entirely to the manufacture of tungsten lamps, the larger quantities of which are made in the forty, sixty and 100-watt sizes. In the manufacture of tungsten lamps it has been the aim of the company to produce a highly efficient lamp which should be known everywhere for quality. The operations through which the tungsten lamps pass are too numerous and varied to explain in this article. However, it may be mentioned in passing, that for the operation of this department a large generating station has been provided for the making of hydrogen and nitrogen gases, and close beside this station is a large holder in which these gases are stored.

In the front of the building (the north end), on the first floor, are the private offices of the general manager and the assistant general manager; also of the correspondence and general offices, as well as the telephone exchange connecting with all departments.

Immediately above these offices on the second floor, and reached by means of a double stairway built of concrete, are the offices of the treasurer and auditor, the engineering department and the manager of works.

On the third floor, and also in the front of the buildings, are the dining rooms. There is a large dining room for the office employés, the foremen and their assistants, and private dining room for the officials of the company. Both dining rooms are directly connected with the kitchen.

Within the organization has been voluntarily formed by the foremen and their assistants, an organization known as the Westinghouse Foremen's and Assistants' Association. This organization has the hearty endorsement of the management of the company and is encouraged in every way in its endeavor to foster and develop a spirit of co-operation, one with the other, in the work of the various departments.

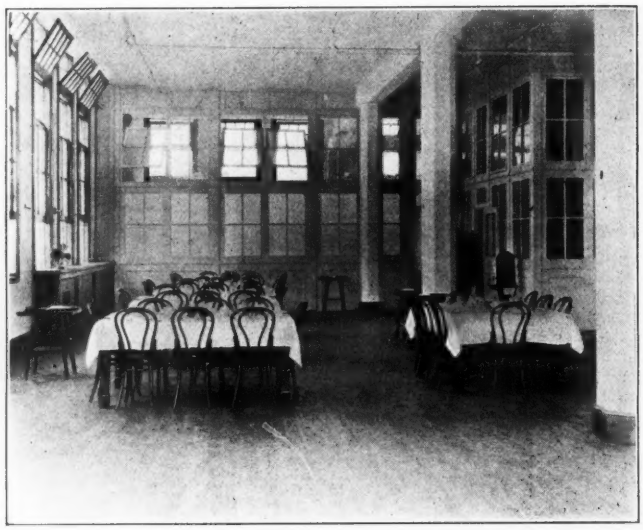
Meetings for the discussion of subjects pertaining to the interests of the company and employés are held at regular intervals, and outings are frequently held during the summer months.

In the near future it is the intention to equip, close by the works, a club, the building for which is now available. A library, reading room, shower baths, bowling alleys, billiard and pool, and other requisites of a modern social industrial club, will be provided.

Close by the works, on the company's property, is a baseball ground, upon which many of the employés play at noon and spare hours.

A unique feature in the organization of the Westinghouse Lamp Company is a dispensary and a rest-room for the employés. A regular physician has entire charge and gives undivided attention to this work, being on hand at all times to render medical advice or assistance when needed. Every needful thing is provided for the care of an employé who may be injured while in the performance of work, and other less important ailments are attended to and the medicine furnished without charge to the employés.

The entire work of designing and constructing was done by Westinghouse, Church, Kerr & Company.



EMPLOYÉ'S DINING ROOM, AND MEDICAL ROOM, WESTINGHOUSE LAMP COMPANY FACTORY, WATSESSING, N. J.

THE DISCOVERY AND DEVELOPMENT OF THE LAWS OF THERMODYNAMICS.[1]—II.

BY DUGALD CLERK.

(*Continued.*)

Rankine, as early as 1849, arrived at the general equation of thermodynamics which expresses the relation between heat and mechanical energy and indicated the result of his investigations to the Royal Society of Edinburgh in February, 1850. Rankine thus arrived independently at the same result as Clausius about the same time. Both Rankine and Clausius, however, adopted certain theories as to the molecular structures and motions of gases, and their demonstrations to some extent depended upon their theories. To Thomson and Joule we are deeply indebted for the rigid proof of the two laws and for the rigid deduction of the modern scale of temperature and the determination of absolute zero in its modern form. Thomson now thus defines temperature:

"The temperatures of two bodies are proportional to the quantities of heat respectively taken in and given out in localities at one temperature and at the other, respectively, by a material system subjected to a complete cycle of perfectly reversible thermodynamic operations, and not allowed to part with or take in heat at any other temperature; or, the absolute values of two temperatures are to one another in the proportion of the heat taken in to the heat rejected in a perfect thermodynamic engine working with a source and refrigerator at the higher and lower of the temperatures respectively."

This definition leads to an absolute scale of temperature which is independent of the substance operated on, and Joule and Thomson's experiments have shown that this scale differs but slightly from that of the ordinary air-thermometer. Joule had suggested to Thomson, in a letter to him in 1848, that the probable value of Carnot's function is the reciprocal of the absolute temperature, as measured on a perfect gas-thermometer.

Thus Clausius appears to have anticipated Thomson, not in the suggestion of an absolute scale of temperature, but in the idea of an absolute zero founded upon the combination of Carnot's law and Joule's law. Thomson, in his papers, very modestly attributes the second law—the law of the transformation of heat—to Carnot and Clausius; but in this he undervalued his work, because Clausius appears to have assumed what Thomson and Joule proved—that is, the coincidence of the absolute scale with the air-thermometer scale.

It will thus be seen that the position usually assumed by the engineer at 1850, of the quality between heat given to the engine and heat given to the condenser, was fundamentally untrue. Without this deduction, however, no determination of values of the Carnot function could have led to the determination of an absolute zero. According to the material theory, as seen in the light of Carnot's cycle, a heat unit could give an indefinitely increased amount of work with lowering of the temperature. Nothing in the theory sets a limit to this increase and, accordingly, there is nothing to suggest an absolute zero. Immediately, however, we accept the dynamical theory of heat we find that one pound of water requires the exertion of 1,390 foot-pounds of work to heat it through one degree centigrade. We also know from the Carnot cycle that, under ordinary conditions of human existence, only a portion of this work can be returned; but as no conditions could conceivably exist in which a greater amount of work could be obtained from one pound of water than the 1,390 foot-pounds put into it to heat it through one degree centigrade, it follows that, inasmuch as the Carnot function increases with diminishing temperature, the limit of temperature is reached when, according to the Carnot cycle, the whole of that work, put into one pound of water, can be got out again as work. This limit is the absolute zero of temperature. No lower temperature is conceivable without introducing the idea of the creation of energy. So far as human beings are concerned, this idea is as inconceivable as the idea of the creation of matter. The determination of this limit with the close accuracy necessary for a well-founded constant is to be entirely attributed to Thomson and Joule. In his 1851 paper Thomson thus succeeds in answering the question which he put to himself in his 1849 paper and he supplies a quantitative method of connecting the amount of the thermal agency necessary with the amount of work which can be performed under varying conditions.

Engineers dealing with motive powers are thus deeply in debt to Thomson and Joule for the secure position occupied by them to-day.

The brilliant work of Meyer, published so early as 1842, is held by some to have anticipated to a large extent both the work of Thomson and of Joule. Undoubtedly Meyer formulated true ideas and carried his generalizations through a wide range. Helmholtz also very early arrived at similar conclusions to those of Joule and Thomson; but it has been thought better to discuss the work of Thomson and Joule separately in order to illustrate the transition period through which many distinguished minds were passing about that time. Undoubtedly, great credit is due to Meyer, Helmholtz, Clausius and Hirn, and Thomson himself recognized this in the most generous way.

The ideas of Thomson and Joule now form so much of the basis of all reasoning upon motive-power engines that there is some little danger to the present generation of forgetting what they owe to these two great men. To appreciate the step made by them it is necessary to consider the position of motive power produced by heat at about the middle of the last century. At that time many attempts had been made to displace the steam engine as a heat engine by air engines in various forms—both engines heated externally and those heated internally, now known as internal-combustion engines. Papers read at the Institution of Civil Engineers in 1845 and 1853, and the discussion of those papers by eminent men of the day, supply an accurate measure of the knowledge possessed by the engineer of the principles of action of his heat engines. Many distinguished names occur in these papers and discussions, including James Stirling, Robert Stephenson, Sir George Cayley, Charles Manby, James Leslie, C. W. Siemens, Hawksley, Pole, W. G. Armstrong (afterward Lord Armstrong), Edward Woods, E. A. Cowper, D. K. Clark, Benjamin Cheverton, Goldsworthy Gurney, George P. Bidder, Professor Faraday, Isambard K. Brunel, Captain Fitzroy and F. Braithwaite. At the date of the later of these discussions Brunel had already designed the Great Eastern, in 1852, with her engines of 11,000 horse-power. Armstrong was a Fellow of the Royal Society, and had started the Elswick Works and invented the Armstrong gun. Robert Stephenson was at the height of his fame. He was then a member of parliament, president of the Institution of Civil Engineers and a Fellow of the Royal Society. Siemens was a young man, but was busy on the regenerative furnace; he had considered regeneration as applied to steam engines, although his work on the air engine was still to come. All were distinguished men in their day, and their opinions may be taken as representing the very best scientific knowl-

[1] Presidential address delivered to the Engineering Section of the British Association for the Advancement of Science, Dublin, September 3.

edge of the leading engineers of the day. The first of the papers to which I refer is called "Description of Stirling's Improved Air Engine," by James Stirling, member of the Institution of Civil Engineers. It was read on June 10, 1845, with Sir John Rennie, the president of the institution, in the chair. The engine described was the later form of the well-known Stirling air engine, invented by the Rev. Dr. Stirling, a Scottish clergyman, in the year 1815. The development considered was the invention of the reader of the paper, a brother of Dr. Stirling. The main improvement consisted in the use of air at a greater density than the atmosphere, and the engine at that date had so far succeeded that two had been used at the Dundee Foundry Company's works, one giving about twenty-one horse-power and the other about forty-five horse-power. Practically, therefore, some success had been attained. Mr. Stirling claimed that the twenty-one-horse-power engine consumed fifty pounds of coal per hour, which is about two and one-half pounds per horse-power per hour. This was an extraordinarily good result for the time. At present, however, we are not interested in the practical result, but only in the opinions of the engineers of the day as to the fundamental principles of heat engines.

It is clear from the paper that the theory of the regenerator was entirely misunderstood. It was imagined that with a perfect regenerator no heat would be required to perform work. This is evident from Mr. Stirling's answer to Sir George Cayley. Sir George Cayley described his engine, which was of the internal-combustion type, acting with solid fuel under constant pressure, and showed that, owing to dust and heat in the cylinder and valves, his experiments proved abortive. He stated, however, that his engine had consumed six and one-quarter pounds of coke—equal to nine pounds of coal—per horse-power. To this Mr. Stirling answered: "It must be remarked that Sir George Cayley in following an entirely different object had overlooked the great leading principle of repeatedly using the same heat," and "he was of opinion that, except on that principle, the air could not be economically used as a moving power." Another speaker, Mr. Cottam, said: "It was evident that, if it was practicable to arrive at the theoretical condition of the absorption of all the caloric by the thin laminæ during the upward passage of the air, and the giving it out again during the downward passage, there would not be any loss of heat." Robert Stephenson did not appear to understand Stirling's air engine at all, because he made the following remarks: "He understood the process to consist of heating the air in a vessel, whence it ascended to the cylinder between numerous thin laminæ, by which the caloric was absorbed, to be again given out to the descending air. Now it appeared to him that, though the ascending process was natural and easy, the reverse action would require a certain expenditure of power, in the depression of the plunger." This remark clearly showed that Stephenson, notwithstanding his eminence as an engineer, at that date had not appreciated the essential conditions of the hot-air engine.

In the year 1853 the subject of the air engine again came up before the Institution of Civil Engineers, interest being excited evidently by the building of the large engines of the hot-air ship Ericsson in America, the engines having air cylinders of no less than fourteen feet in diameter. Four papers were read in this year: "On the Use of Heated Air as a Motive Power," by Benjamin Cheverton; "On the Caloric Engine," by Charles Manby; "On the Principle of the Caloric Air-Heated Engine," by James Leslie, member of the Institution of Civil Engineers, and "On the Conversion of Heat Into Mechanical Effect," by Charles William Siemens, associate member of the Institution of Civil Engineers.

Cheverton evidently considers, from his paper referring to Stirling and Ericsson, that "both parties also rest the efficiency of their engines on the repeated use of caloric. They contend that in recovering from the ejected hot air the caloric which gave it superior tension, and employing it in heating the injected air, 'it is made to operate over and over again.' Mr. Ericsson aspires to embody a new principle in motive mechanics—no less, to use his own words, than 'that the production of mechanical force by heat is unaccompanied by the loss of heat,' except such as arises from radiation, or other practically unavoidable waste." Cheverton rejects this idea, but, strangely enough, does not appear aware of the work either of Carnot or of Joule. He comes to the conclusion, however, that "caloric, doubtless, is in all its aspects a manifestation of force, and unquestionably, as a mechanical agent, of a dynamic force, and therefore is directly amenable to the third law of motion." He appears to think that heat is accompanied with molecular activity, but is puzzled by what he accepts to be a fact, that in the steam engine the whole of the heat of the steam as it comes from the boiler is found in the condenser. With regard to the steam he says: "Undoubtedly, in respect to the materiality of caloric, if it be material, it is transferred intact to the condenser, yet in its passage it may have parted with force, which it can not communicate again." He comes to the conclusion that the change may take place not in the quantity, but in the intensity of heat. Here he resembles Carnot; but it appears to him impossible to arrive at any useful theory of the heat engine, because he states: " . . . for every investigation leads to the conclusion that the effect of caloric is independent at least of the chemical, if not also of the physical, constitution of bodies. But economy of fuel is a different question from the economy of caloric; it is altogether a practical matter, and can only be determined by experiment; for this, and, indeed, most other points of practice, are too intractable to come within the grasp of the most powerful calculus." In the discussion a communication was read from Sir George Cayley, in the course of which he states, with regard to the regenerator: "There can exist no doubt of the effective reapplication of heat to an almost unlimited extent by this beautiful invention, due originally to Mr. Stirling, and now carried out to a greater extent by Captain Ericsson." Sir George Cayley discussed the difficulties of Ericsson's engine, but he accepts the principle that heat may give work and yet be used over and over again practically undiminished. Armstrong did not express himself upon the theory at all but he was doubtful as to the advantage of the air engine compared with the steam engine, although he believed that it was practicable to recover and use over again a large proportion of the heat applied, and he thought the balance of economy, so far as heat was concerned, would be found in favor of air. Siemens agreed to some extent in the advantages of a regenerator, but he showed clearly that expansion doing work was accompanied by a diminution of temperature, and stated that this heat had to be replaced by the fire. Bidder was of opinion that "no theoretical advantage was obtained in using heated air instead of vaporized water as a motive power, and it was incapable of being applied practically with as much convenience." It is most interesting to note that Dr. Faraday joined in this discussion. He said very little, and I will give his remarks complete. Dr. Faraday said: "Twenty years ago he had directed his attention to this

question, and from theoretical views he had been induced to hope for the successful employment of heated air as a motive power; but even then he saw enough to discourage his sanguine expectation, and he had, with some diffidence, ventured to express his conviction of the almost unconquerable practical difficulties surrounding the case, and of the fallacy of the presumed advantages of the regenerator. He still retained his doubts as to the success of the innovation, and feared the eventual results, even of Captain Ericsson's spirited and ingenious efforts." Brunel considered the use of the regenerator to be an entire fallacy, and did not believe that the power derived from the expansion of air by heat could be used effectively and then be recovered and used again. Mr. Hawksley considered that the machine involved a mechanical fallacy and that the regenerator produced no mechanical effect whatever. Mr. Rendel was the president at the meeting which dealt with Mr. Cheverton's paper, and, in view of the great difference of opinion on the subject, he stated that "he would not have the meeting arrive at a hasty or erroneous conclusion on the question of this engine, and he therefore suggested that Mr. Siemens should draw up a paper on the subject, and that the members should collect, for a future meeting, all the information within their reach, in order to bring about the calm and deliberate discussion of the question." This resulted in the further meeting of May 17, 1853, when papers were read by Manby, Leslie and Siemens. The paper by Manby consists of the summary of a discussion by M. Galy-Cazalet, which took place in Paris in 1853. M. Galy-Cazalet comes to the conclusion that the regenerator involves a fallacy, and he concludes: "There appears to be at present so much doubt of the utility of the regenerator that it would be wise to abandon its use for a time, and by trials with a more simple form of caloric engine establish the fact either of the superiority or of the inferiority of heated air in comparison with steam as a motive power." Mr. Leslie, on the contrary, in his paper upholds vigorously the accuracy of the principle of the regenerator or economizer. He comes to the conclusion that it is based on true principles and is attended in practice with real economy of heat, and consequently of fuel. In this conclusion he is doubtless correct; the regenerator is useful and does economize heat. But Leslie goes much further than this; he appears to support Stirling in the fallacy that the regenerator may be made indefinitely useful. Stirling states:

"And thus it appears that by applying air successively to a series of bodies regularly increasing in temperature, and moving alternately from one end of the series to the other, it may be heated and cooled ten times, with an expenditure of caloric which would barely have heated it once, if it had been applied at once, to the hottest body—*i. e.*, beyond the series. It is evident, also, that if the series had been composed of twenty points, or bodies, having a difference of temperature of five degrees, the air might be heated and cooled twenty times at no greater expense of caloric. Nay, it is evident that by multiplying the members of the series indefinitely air could be heated and expanded and made to do work at no appreciable expense. But let no mathematician be alarmed with the idea of a perpetual motion, or the creation of power. There are many enemies to contend with in the air engine besides friction, which alone prevents perpetuity in some mechanical motions. We have no means, without consuming a part of our power, of applying the air so closely to the apparatus as to make it absolutely assume the temperature of the bodies to which it is applied. There is, therefore, a loss in the very act of heating and cooling."

Leslie comes to the conclusion that Stirling is right, but that an air engine without a regenerator would be a much less effective and economical application of heat than the steam engine. Leslie gives some interesting particulars of the later air engines of James Stirling. He states that an engine of forty-five horse-power was started in March, 1843, at the Dundee Foundry; that in December, 1845—two years and nine months after starting—one air vessel gave way, and in May, 1846, another failed, and in January, 1847, a third failed. This information was supplied to him by David Mudie, one of the lessees of the foundry.

(To be concluded.)

Explosion of the Gas-Bag Balloon at the Franco-British Exposition.

At the investigation, in the Hammersmith's coroner's court, to discover the reason for the explosion of the Lovelace gas balloon which occurred at the Franco-British Exposition some weeks ago, interesting information, says the *Electrical Engineer*, London, September 11, concerning the liability of sparks from electrical connections was brought out. The airship was kept in a tent open at both ends and with two openings on each side for ventilation. The interior of the tent was illuminated by electric lamps. A continuous wire ran along the poles and incandescent lamps were suspended from this wire. The wires were conducted through the ground to prevent short-circuiting, and the additional precaution of using cutout plugs had been taken. The envelope of the balloon was seventy-five feet in length and sixteen feet in diameter, cylindrical, and had a net over it for the purpose of suspending the machinery. An electric fan was used to circulate the air in the bag when the gas had expanded through the heat of the sun and to expel the foul air from the tent. The condition of the bag was tested by blowing air in by means of the fan for the detection of the presence of holes. In his evidence before the coroner, the owner of the air-ship, Captain Lovelace, stated that after the explosion he had examined the electric fuses and also the cutout plugs, and they were all right. The fan was driven by means of a wire run to a lamp socket. There was a switch on the fan, and unless the fan were turned over there would be no sparking. The assistant balloonist, in his evidence, said that when the bag was about two-thirds full of hydrogen gas, and for the purpose of distending it, another assistant sat on the ground and held the neck of the bag over the electric fan. The flames from the burning balloon, rushing down the neck, set fire to his clothing. Another witness stated that he saw the balloon being filled by the electric fan. Expert witnesses testified that the electrical arrangements were excellent, and that sufficient precautions had been taken so that if the tent were blown down the current would have been shut off. The fan was of good make, and was of a kind that frequently sparked. There was sometimes a spark in the brushes, but there was always a small spark at the switching off. If there was dust in the fan there would be some likelihood of sparks. The spark, though very minute, if formed in an atmosphere of hydrogen and oxygen, would be sufficient to cause an explosion. The jury, after some deliberation, returned a verdict to the effect that the deaths were caused by burns through the accidental explosion of the gas bag due to the use of an electric fan for pumping air into it. It added a rider to the effect that it considered the use of the fan to have been dangerous under the circumstances.

Breakdown of Electrical Machinery.

The report of M. Longridge, chief engineer of the British Engine, Boiler and Electrical Insurance Company, always forms interesting reading, and from the abstract of this report, published in the *Electrician*, London, we have been pleased to extract the following paragraphs:

The rate of breakdown was 1 in 11.7 among steam engines and 1 in 11.1 among gas and oil engines, as compared with 1 in 8.1 and 1 in 12.4, respectively, last year. It is interesting to observe that in both types of engine the valves and valve gear are believed to have failed more frequently than any other part, and that whereas the percentages of failures due to this cause in the twenty-four years previous to 1906 were twenty-one per cent for steam engines and 32.5 per cent for gas and oil engines, these figures stand at twenty-eight and 43.3 per cent, respectively, for the year 1907. Also in the case of gas and oil engines the next highest percentage of failures—*viz.*, only 13.5 per cent—was attributed to cylinders and cylinder ends, thus showing apparently that the weak point of this type of engine is its valves.

The chief engineer's remarks on this subject are as follows:

"The increase in the number of breakdowns of steam engines traceable to failures of valve gears is probably the result of increase in speeds and number of parts. The reduction in the number of breakages from spur gearing is the natural consequence of the substitution of rope and direct driving for the older system of transmission. The steady increase in the number of broken cylinders and pistons is due principally to the use of steam at temperatures and pressures higher than the parts can safely bear. The reduction in the number of main shafts broken is remarkable and inexplicable.

"In gas and oil engines the increase in breakages of valves and valve gears is not satisfactory, and demands the serious attention of makers of these engines. If all side shafts were fitted with ring lubricators and levers made of wrought iron or good cast steel the percentage in the table would be reduced. The reduction in broken cylinders and pistons is encouraging and marks the progress which is being made. Connecting rods proved less destructive than usual, probably because of improvement in design, particularly as regards strength of bolts. Breakages of crank shafts were fewer than in 1906."

An increase is again reported in the electrical branch of the business, and the number of breakdowns of dynamos and motors in 1907 exceeded the number in 1906 by 18.1 per cent, so that insurance is proving a benefit to the users of electrical machinery. The rate of breakdown was rather lower among dynamos and rather higher among motors than in 1906. The exact figures are 1 in 18.7 among dynamos and 1 in 7.9 among motors. The corresponding figures for 1906 were 1 in 16 and 1 in 8.2. Again, as in 1906, the rate among continuous-current machines was much higher than among alternating, but, on the other hand, the average cost of each breakdown was much less, so that the company's practice of charging practically the same rates of premium for both types of machine is fully justified. The proportions in which the various parts of the machines are thought to have caused or initiated the breakdowns of 1907 are tabulated below:

Part Which is Believed to Have Failed First.	Dynamos. 1906. Per Cent.	Dynamos. 1907. Per Cent.	Motors. 1906. Per Cent.	Motors. 1907. Per Cent.
Armatures and rotors	50	35	44	38
Magnet coils and stators	11	7	14	14
Commutators and brush gear	20	34	28	30
Miscellaneous	19	24	14	18
	100	100	100	100

Starting Switches and Controllers.	1906. Per Cent.	1907. Per Cent.
Resistance coils	48	60
Contacts and switch arms	10	8
Automatic apparatus	17	13
Miscellaneous	25	19
	100	100

The causes of these breakdowns were probably as follows:

	Dynamos. 1906. Per Cent.	Dynamos. 1907. Per Cent.	Motors. 1906. Per Cent.	Motors. 1907. Per Cent.	Starters. 1906. Per Cent.	Starters. 1907. Per Cent.
Accidental	15	8	9	4	22	9
Dirt and neglect	14	25	19	28	11	16
Age and deterioration	21	23	25	23	23	27
Bad work or design	23	21	18	18	9	8
Overloading	0	0	2	1	7	5
Unascertained	27	23	27	26	28	35
	100	100	100	100	100	100

The following interesting and typical examples of breakdowns during the year have been selected from the report:

1. Protected three-phase, alternating-current fifty-horse-power motor, one year old, taking current at 500 volts and running at 750 revolutions per minute. The breakdown can be well described in the inspector's own words. "This motor," he says, "broke down and I examined it today. I found that six of the stator coils have been completely stripped and about fifteen of the rotor coils are badly damaged. I can only suppose that some foreign substance got into the machine when it was running and simply demolished all the coils which were in its path, for the case was full of small bits of copper. The rotor is damaged just in one place, and from the nature of the damage great force has been expended at that point, so I can only surmise that something has caught in the rotor winding and gone round the coils. As is frequent in such cases the driver of the machine swore that the current was switched off and the rotor at rest when the accident occurred, so he evidently knew more about it than he would tell, but I could get nothing further out of him." The motor, as stated above, was protected, but the inspector said it was quite possible for things capable of doing the damage to get in. There is little doubt that something did get in, but what it was was not, and probably will not be, discovered. There is no question of the rotor windings having been lifted by centrifugal force, as the binders were intact.

2. Four-pole, totally enclosed, series-wound eight-horse-power motor, two years old, driving a winch in a shipyard with current at 480 volts; speed, 700 revolutions per minute. The fuse, a No. 16 Standard Wire Gauge, tin wire, having melted, one of the company's inspectors was sent for to examine the motor. He found the solder all around the end connections of the armature conductors partly melted and, on taking out the armature, four coils were seen to be completely burnt out. Wedged into the space between two of the conductors and the end of the core was a piece of cinder which, no doubt, was the cause of the trouble. How it got there in an enclosed motor is a mystery. The only suggestion the writer can make is that the armature must have been set down upon it or rolled over it at some time when taken out and that movement of the conductors while the motor was running had caused it to rub through the cotton covering and short-circuit the coils.

3. Semi-enclosed, two-pole, centre-hung, shunt-wound two-and-one-quarter-horse-power continuous-current motor, taking current at 500 volts, and driving a fan in a smithy at a speed of 2,400 revolutions per minute. According to the statement of the attendant a belt of flame ran around the commutator when he started the motor. When he stopped it he found the remains of two rats wedged between the armature and the frame, but could discover no injury to the conductors. By testing, however, the company's inspector, who had been sent for, found a break in one of the end connections, close to the commutator, which had, no doubt, caused the sparking. Whether one of the rats was accountable for the breakage was uncertain.

4. Two-pole, totally enclosed, shunt-

wound, four-horse-power Lundell motor, taking current at 230 volts, and running at 1,100 revolutions per minute. The company's inspector was sent for because smoke was issuing from the joints of the carcass. He examined it, ran it, and tested the insulation without discovering any fault. He then had it opened and discovered that the smoke had come from the ignition of a quantity of oil, dust and dirt which had accumulated upon the bottom of the circular magnet coil by sparks from the brushes, and that the sparking had been caused by one of the carbon blocks getting jammed in its brush-holder. The insulation of the magnet coil was also slightly charred. This was patched up, the brush-gear put in order, and the motor cleaned and started. Since then it has given no further trouble. This is quite a typical case. Fires inside motors started by the ignition of collections of fluff and dust are not uncommon.

5. Four-pole, shunt-wound, semi-enclosed motor, about two years old, giving eighty horse-power at 500 revolutions per minute with continuous current at 500 volts, and protected by two No. 16 Standard Wire Gauge, copper wires fusing with 332 amperes, or two and one-half times the maximum current supposed to be carried by the machine. The fuse melted and, on examination, two of the armature coils were found burnt. The remaining coils were saturated with oil and very dirty. The insulation of the commutator segments was also burnt close to the spokes through oil and dust settling between the spokes and short-circuiting them. This insulation, instead of being carried up a short distance, say, one-quarter inch or so, between the spokes, ceased at the ends of the bars, leaving very narrow wedge-shaped openings between the edges of the spokes to hold oil and dust. The machine was so damaged by dirt and neglect that the armature had to be entirely rewound, and the commutator rebuilt and reinsulated. It was only accepted for insurance about eleven months previous to the breakdown, and was then in good condition. It seems, however, that it had then just had the benefit of a thorough repair in consequence of a similar breakdown at the end of its first year's work.

6. Two-pole, continuous-current, shunt-wound motor-transformer working in a substation of a lighting supply, receiving forty-four amperes at 1,080 volts and transforming to 110 volts. Normal speed, 470 revolutions per minute. When started from the central station on the evening of the breakdown the armature gained sufficient speed to break one of the steel binders at the high-tension end and spread the conductors until they jammed themselves fast between the pole-pieces. On examination it was found that one end of the shunt winding had slipped out of its terminal. One of the attendants who had cleaned the machine in the morning declared that the wire was then in place, and suggested that it must have been shaken out of the terminal by vibration when the machine was started. It is far more likely that he pulled it out with the duster or waste he was using, for the wire had simply been slipped under the binding screw, and not bent around or over the terminal block. The case is mentioned because the number of shunt wires broken or pulled out of their terminals proves that such wires ought to be better protected and more efficiently secured than they generally are.

7. Four-pole, compound-wound dynamo, three years old, giving ninety amperes at 250 volts when running at 850 revolutions per minute. The commutator contained 153 segments insulated, with one exception, by mica plates. The exception had micanite. The two coils in connection with this segment were burnt out and had to be replaced. The cause was a short-circuit across the micanite insulation, produced by carbon dust and oil which had penetrated into the micanite. The other segments were quite as dirty, but the mica plates between them had kept up the insulation. The company's experience undoubtedly is that pure mica is to be preferred to micanite or made-up mica for insulating commutator bars.

8. Seven-horse-power, three-phase motor of foreign manufacture driving the hoisting winch of an overhead crane with alternating current at 190 volts. The three leads to the slip-rings were fused. On examining the rotor it was found that the core plates had been treaded upon the shaft and a ring shrunk on at each end to hold them. There was no key or feather to prevent them turning. The conductors were led over the ends of the core through a hole in the shaft, which was hollow, and out at the end to the slip-rings. This hole had sharp edges and was not bushed with insulating material. The consequence was that the rotor got loose and rocked upon the shaft, rubbing the insulation of the leads where they entered the shaft and short-circuiting them.

9. Four-pole, shunt-wound, ventilated motor, seven horse-power, fourteen and one-half amperes, 400 volts, 1,000 revolutions per minute, driving machine tools. Fuse when insured, one No. 16 Standard Wire Gauge, tin wire, subsequently replaced by a cartridge "Mordey" fuse of twenty-five amperes. On receipt of a message by telephone that the motor had broken down an inspector was sent to examine it. He found that the armature had been taken out and sent to the maker's works, whither he followed it. There he found that two of the conductors were broken, one close to the commutator lug and the other so close to the core as to necessitate lifting the coil, and as this could not be done without lifting the other coils the repair meant rewinding the armature. He also learned that the makers had been sent for some months before on account of bad sparking, and had then warned the owner that the machine was overloaded. With this information the inspector went back to the owner's works as soon as the armature had been repaired and replaced, and measured the current required to run all the machinery which the motor drove. He found it to be twenty to twenty-one amperes. The owners then admitted that they had added some machines since the insurance was effected, and promised to make inquiries as to the price of an additional motor.

The Railway Signal Association.

The twelfth annual convention of the Railway Signal Association will be held at the New Willard Hotel, Washington, D. C., October 13, 14 and 15.

On October 13 sessions will be held at 10 A. M. and at 2 P. M. The morning session will be devoted to the president's address, the report of the secretary-treasurer, and reports of standing committees. The afternoon session will be devoted to considering amendments to the constitution, and papers on electric interlocking, mechanical interlocking and storage batteries.

On October 14 a session will be held at 9 A. M. to take up a discussion of signal practice, standard design, automatic stops and cab signals, and subjects and definitions.

On October 15 a session will be held at 9 A. M., taking up automatic blocks, rubber-covered wire and manual blocks. The selection of a place for the next annual meeting and the election of officers will be consummated at this session.

LETTERS TO THE EDITOR.

State Branches of the National Electric Light Association.

To the Editor of the Electrical Review:

The editorial in your issue of the nineteenth on the Pennsylvania Electric Association becoming a state branch of the National Electric Light Association I have no doubt was inspired by the best of motives, yet I feel it would form in some minds a wrong impression, and hasten to correct same.

One might gather from reading it that the scope of the state branches of the National Electric Light Association might be restricted, or the policies dictated, by the parent body. Such is not the case. All the individuality of the state association is retained. While all the members of the state branch will be necessarily members of the national association, on the other hand, any member of the national association can be refused admittance to, or expelled from, the state branch.

The centralizing of the clerical work has some economic value, but is of minor importance in affiliating with the national. The real advantage to the state branches will be the co-operation of their committees with those of the national; the use of the greater facilities for data and guidance in preparing papers and carrying on such work as needs influence and superior council. Besides, its acts will have greater prestige if backed up with all the power of the National Electric Light Association.

The national, on the other hand, gets a larger membership, and is fulfilling its mission more thoroughly by keeping closer in touch with the whole industry at large, by closing in a lot of loose ends, becoming the connecting link between all these associations, thus increasing both its power and prestige.

L. H. Conklin.

Connellsville, Pa., September 21.

[And this is exactly what we said, or thought we said. And we are glad to publish Mr. Conklin's letter, so that there will be no misunderstanding.—Ed.]

Symbols for Physical Quantities.

To the Editor of the Electrical Review:

Now that there has been some opportunity for discussing this question, may I be permitted to summarize the arguments that have been raised for and against the creation of new symbols?

The most common objection is, "They are like Chinese characters; we could never remember them." But there will be no necessity to remember them. How many of us can remember what symbol Rankine uses for kinetic energy? Is it not sufficient for us if we see it when we refer to his book? Every considerate writer to-day gives a list of the symbols he uses. If all writers used the same symbols we should soon become familiar with those with which we are most concerned, and for the rest, we could refer to the list just as at present.

Some objectors do not see why the letters we have at present are not sufficient. Let them try to make a list of symbols for the 200 physical quantities for which symbols are wanted. After they have made up a list to satisfy themselves (if such a thing is possible) let them try to convince some one else to adopt that list.

There are about twenty letters such as m for "mass" t for "time," etc., upon which there is almost universal agreement. One or two dozen more stand a fair chance of being agreed upon. Beyond these there is hopeless confusion, simply because all the good letters are exhausted.

As to the difficulty of printing new symbols, it is of interest to know that twenty-five of the leading technical journals of the world published an article containing five new symbols given as examples without any difficulty. Several of them have expressed the view that there is no difficulty from the printer's point of view. The types supplied to them—which, by the way, cost two cents for thirty—were all of one size, and yet each paper used for the text of the article its usual standard type. The publisher of the *Elektrotechnische Zeitschrift* thinks that there would be no difficulty in arranging with a type founder to make matrices, from which all printers could be supplied with type. Each printer would keep in stock those types which commonly occurred in his paper, and could get others on short notice. About thirty new symbols would be sufficient for articles on electrotechnical science.

Two papers have objected that the symbols can not be set up on a linotype machine. It is, however, usual at the present time to set up mathematical expressions by hand.

Several critics have pointed out that the new symbols should be simple and bold in outline, so that they can not be easily mistaken for one another. This, of course, is an important matter to bear in mind.

I agree with M. Galliott that the name of the symbol should be, where possible, the name of the physical unit represented. Where the name of the unit can not be employed, a word of one syllable might be chosen, as for instance, "stroke" for the length of a piston stroke.

Some critics say that the number of symbols required would be too great. As to that, we can make just as many as convenient. The symbol became universal almost as soon as it was printed. Let us have a few more as good as that one; we are badly in need of them.

Jules Walker.

Hale, Cheshire, England, September 19.

The Edison Rate Decision.

To the Editor of the Electrical Review:

In your editorial on the Edison Rate Decision, you say that the Massachusetts Gas and Electric Light Commission has gone squarely on record against the modified Wright demand system used by the company.

I do not interpret the decision this way at all. The recommendations of the board are three:

First, that the company should establish a maximum rate of twelve cents.

Second, that it should not make any special rates in the form of personal discounts.

Third, that it should not make any special rate to municipal customers, as such.

All the company's other rates are tacitly approved, though the hope is expressed that ultimately the maximum rate may be made low enough so that the various long-hour and wholesale discounts made by the company for various classes of service, may no longer be necessary.

The latter, as you will note, is what the lawyers call *obiter dictum*, as with most of the criticisms made by the board on the Wright demand system.

The board states that it is impossible to compute exactly the cost of supplying individual customers, and that it is desirable that all these costs should, for the small customer, be averaged into a uniform rate, but speaks with approval of the differential rates on the Wright demand and wholesale basis, as developing business that enables the rate to the small customer to be lower than it would be if these systems were not in use.

If you will look back through various other decisions of the board you will find that they have been along much the same line; that the board would like to see a uniform flat rate and has in many cases recommended a uniform flat rate as a maximum. Except when recommending

a uniform flat rate, as a maximum, the board's remarks have invariably been *obiter dicta* and there are numerous cases on record where the board has clearly recommended differential rates, sometimes on the basis of wholesale and sometimes on the basis of long-hour.

It is obvious that this must be the case. For instance, the Boston arc lights are to-day being supplied at a price of approximately $120 a year for a use of approximately 2,000 kilowatt-hours a year.

On the basis of the twelve-cent rate as recommended by the board for the Boston Edison Company, the Boston Edison Company would be entitled to charge the city of Boston, approximately $240 per year per arc lamp. Can any one imagine the board endorsing such a price for street arc lamps in Boston, or justifying an order for a lower price on anything else than the principle of the Wright demand system?

BOSTON.

September 21.

A New Scale for Incandescent Lamp-Measuring Instruments.

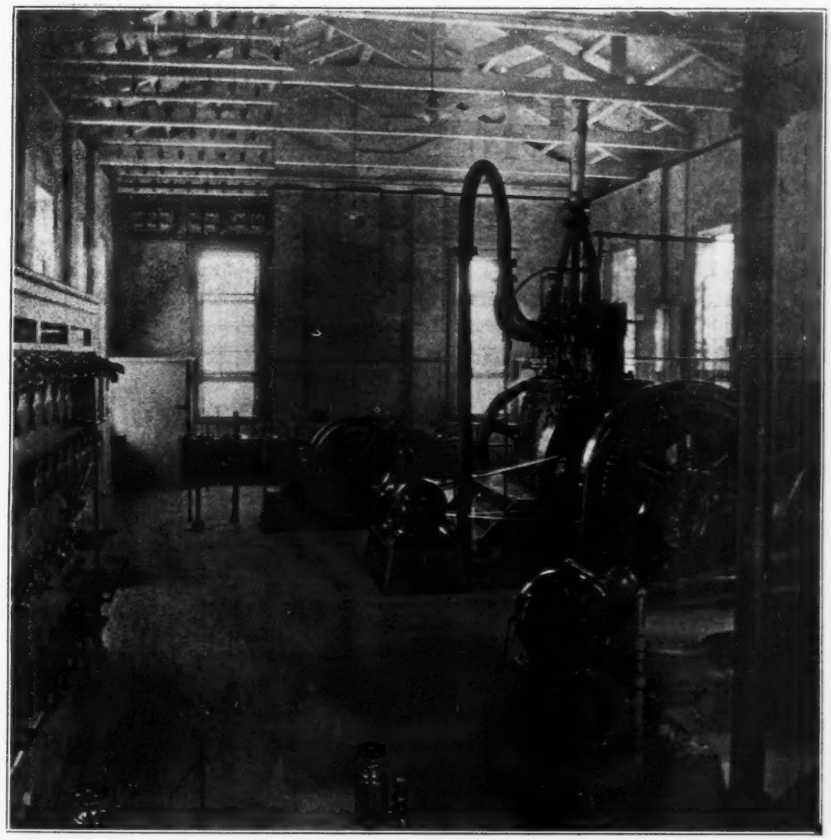
The ingenuity which German manufacturers exercise in their efforts to develop the use of electric light is evidenced by a new scale put on the market by the firm of Nadir, Berlin, says *L'Electricien* (Paris). This scale makes it possible to read directly, in tenths of pfennigs (one pfennig equals one-quarter cent), or even in smaller fractions, the cost price per hour of operating any type of lamp. The same apparatus, which thus gives to the inexperienced consumer more tangible and definite information than any explanation regarding electrical units, also makes it possible to read the consumption in watts and amperes. The standard instrument is applicable to 220-volt circuits, where the current costs ten cents a kilowatt-hour.

Magnetic Club Anniversary.

The twentieth anniversary of the Magnetic Club will be celebrated at the regular fall dinner, to be held at the St. Denis Hotel, New York city, on November 18. On this occasion it is expected that delegates from the Telegraphers' Mutual Benefit Association will be in attendance as guests, as has been the custom for the past fifteen years.

Electric Plant at Coeymans, N. Y.

The Atlantic Light and Power Company, Coeymans, N. Y., was organized in response to a popular demand for better lighting service than that formerly furnished by the Upper Hudson Electric Company. As a municipal plant was not legally possible, the leading citizens of Coeymans, Ravena and New Baltimore organized this company. It has so satisfactorily fulfilled its purpose as to very nearly drive its competitor from the field in these villages (about twelve to fourteen miles south of Albany), and has the moral support of the inhabitants of Coxsackie where the competing plant is located.



ENGINE ROOM, ELECTRIC LIGHT PLANT, COEYMANS, N. Y.

The Coeymans plant supplies street and commercial lighting in Coeymans, Ravena and New Baltimore, and lights the station and yards of the West Shore Railroad at Ravena. The street-lighting system consists of over two hundred forty-candle-power tungsten lamps on a series circuit, which are carried on a contract at $20 per lamp per year. The railroad uses twenty-one arcs and 200 incandescents on multiple circuits. The present commercial lighting load is about 200 tungsten lamps, which the company furnishes to consumers at cost, and about 1,500 fifteen-candle-power incandescents. The lighting rate is twelve cents per kilowatt-hour with a sliding scale of discounts.

The power service has not yet been developed as the plant has been in operation only since February 29, 1908. Preparation has been made on the switchboard, however, for a power circuit. The power rate will be from ten cents down to two and one-half cents per kilowatt-hour.

The power plant contains two duplicate eighty-five-kilovolt-ampere sets, making a total capacity of 170 kilovolt-amperes. It is intended, however, that only one set shall be used at a time, the other being kept as a spare. In case of an increase of the load beyond the capacity of one set, duplicate additional sets will be installed. This provision has secured many customers for the concern as it assures continuous service. The fact that the Crocker-Wheeler generators used are easily paralleled obviates the sudden fluctuations which were had with the old service when throwing the load from one generator to another.

The power-house consists of a brick and cement structure thirty-two feet by

sixty-six feet and eighteen feet high at the eaves. The roof is of wood, covered with corrugated iron, and the floor of cement.

The generating sets consist of Crocker-Wheeler generators coupled direct to Diesel oil engines. The engines, each rated at 120 horse-power and having three cylinders, twelve inches by eighteen inches, were built by the American Diesel Engine Company, of New York. They burn crude oil, which is injected into the cylinders by means of compressed air at a pressure of 900 pounds. For this purpose each engine has belted to it an Ingersoll-Rand nine and one-quarter by three by ten two-stage compressor. Cooling water is circulated by a Pyramid four by five pump, belted to each set.

Two 7,500-gallon oil tanks are located about thirty feet from the building. These are buried in the clay soil to exclude water due to sweating. In addition a 10,000-gallon tank is provided at the railroad, from which the oil is carried to the storage tanks in a tank wagon.

A 14,000-gallon cooling tank is installed at the rear of the building. This is of wood, supported on a concrete foundation. The water is delivered as a spray at the top of a series of wooden steps down which it is allowed to drip to the tank.

The generators are thirty-two-pole, eighty-five-kilovolt-ampere, 2,300-volt, two-phase, sixty-cycle machines, at 225 revolutions per minute. They were built by the Crocker-Wheeler Company, of Ampere, N. J., and are of the same general type as the larger machines built by the company, which operate particularly well in parallel with each other or with machines of other types. The winding of the revolving field consists of strip copper wound on edge, which affords radiating surface for each turn of the winding, thus insuring cool running. The ventilated type of core and housing also insures thorough circulation of air. The use of magnetic wedges in the core slots is a feature of these generators. It permits the use of form-wound and pre-insulated coils and solid pole-shoes.

The exciter belted to each generator is a Crocker-Wheeler Form I, 6.5 kilowatt, compound-wound generator, running at 1,100 revolutions per minute.

The switchboard is composed of six panels of blue Vermont marble, ninety inches high and with a total length of about twelve feet. The panels are Crocker-Wheeler type 12. The first two panels at the left are combined generator and exciter panels. The next two are feeder panels, each containing two single-phase circuits. Of these, one circuit is provided for commercial lighting in each of the villages of New Baltimore, Coeymans and Ravena, and the fourth circuit supplies the railroad lighting. Each of these circuits contains a Crocker-Wheeler single-phase feeder regulator, capable of regulating the voltage of the circuit ten per cent above or below the bus-bar voltage. The fifth panel contains three 150-light series incandescent systems for street lighting, with Wood regulators situated behind the board. Integrating wattmeters are provided on this panel, to check up the cost of the street and commercial lighting.

The pole line is of such height that the wires are suspended above the lines of the telegraph and telephone companies and above the lines of the old lighting company, some of which still remain. All lines are provided with lightning arresters at the switchboard, at the first pole and at various points along the lines. All guy wires are provided with strain insulators to protect pedestrians, and pole transformers are grounded. Street lamps are permanently suspended from the poles on six-foot and eight-foot arms of one-inch pipe, from the ends of which the lamps are insulated by means of glass petticoat insulators in Philadelphia fixtures, with General Electric sockets and receptacles.

The cost of fuel and lubricant for the engines is very low, not exceeding forty gallons of fuel and one and one-half gallons of lubricant per day; the station output being about sixty horse-power for ten hours and very light for the other fourteen hours.

The president of the company is John N. Briggs, of Coeymans, and the consulting engineer for the plant is H. B. Sweet, of Utica, N. Y.

BOOK REVIEW.

"Electrical Contracting." Louis J. Auerbacher. New York. McGraw Publishing Company. Cloth. 156 pages. 5½ by 8½ inches. Illustrated. Furnished by the ELECTRICAL REVIEW for $2.

In this book the author has gathered together a goodly amount of very practical information, especially for the wireman and contractor. While it is a good thing to be possessed of considerable technical information in undertaking to carry out the work on the excellent lines which the author has laid down, the instruction is given in so clear and lucid a manner that the book will be found of great value to the man on the street who is desirous of making a minor installation. Mr. Auerbacher has had a great deal of experience in the field as a workman, foreman and employer, and his capability is reflected in the presentation which he has made in the present volume.

Meeting of the American Association of Electric Motor Manufacturers.

The fall meeting of the American Association of Electric Motor Manufacturers took place at Frontenac, Thousand Islands, N. Y., September 9, 10 and 11. During the meeting the following papers were presented, with a view to bringing forth discussion, thus enabling the various committees to incorporate in their reports recommendations for the adoption of uniform practices in the manufacture of electric motors, to the end that the highest quality of electric motors may be manufactured by the members of this association:

"Ratings and Guarantees on Direct-Current Motors," by J. M. Hipple. Presented by W. T. Hensley.

"Ratings and Guarantees on Alternating-Current Motors," by C. S. Reno.

"Ratings and Guarantees on Variable-Speed Motors for Elevator Service," by W. J. Warder, Jr.

"Freight Traffic," by W. B. Everest.

The various committees appointed at the former meeting have collected considerable information of value for dissemination among the members of the association.

At this meeting W. H. Tapley was regularly installed as the permanent secretary of the association, J. C. McQuiston, who has acted as temporary secretary since the formation of the association, retiring.

The association has provided permanent headquarters in the Engineering Societies Building, 29 West Thirty-ninth street, New York.

The next meeting will be held about the middle of January, 1909.

A considerable amount of business was transacted during the three days of the meeting, but time was found, however, on Thursday afternoon, September 10, for recreation, there being three contests: one for golfing, one for bowling, and the third for fishing. The golfing trophy, a cup, was won by Charles Robbins, of Pittsburg; the bowling prize, a silver cup, was won by W. S. Kemp, of Brookline, Mass. The prize for the largest fish caught—a rod, line and reel—was captured by F. M. Kimball, of Boston.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

MEXICAN TELEGRAPH COMPANY.

The Mexican Telegraph Company reports for the quarter ended September 30 (partly estimated) as follows: Traffic receipts, $160,000; operating expenses, $42,000; net earnings, $118,000; interest accrued, $26,000; total income, $144,000; less Mexican Government's proportion of earnings for current quarter, $7,500; balance, $136,500; to provide for October dividend, $71,752; surplus, $64,748; previous surplus, $2,559,850; total surplus, $2,624,598.

CENTRAL & SOUTH AMERICAN TELEGRAPH COMPANY.

The Central & South American Telegraph Company reports for the quarter ended September 30 (partly estimated) as follows: Traffic receipts, $365,000; operating expenses, $165,000; net earnings, $200,000; interest accrued, $4,500; total income, $204,500; amount required for October dividend, $143,565; surplus, $60,935; previous surplus, $1,279,133; total surplus, $1,340,068.

BROOKLYN RAPID TRANSIT.

Gross earnings of the Brooklyn Rapid Transit Company since the beginning of the new fiscal year on July 1, show a decline of between six and seven per cent compared with the same period last year. Comparison is being made, however, with record-breaking earnings, the September quarter in 1907 being the biggest in the company's history. Practically all of the falling off in gross has been in beach traffic, upon which the company has never been able to make any show of net earnings, so that net earnings for the current quarter are not likely to fall materially behind those of last year.

MINNEAPOLIS GENERAL ELECTRIC COMPANY.

The report of the Minneapolis (Minn.) General Electric Company for the month of July and twelve months ended July 31, is as follows: July gross, $73,889; expenses, $32,025; July net, $41,864; charges and taxes, $32,400; July surplus, $9,464, as compared with $10,666 for July, 1907. Twelve months' gross, $961,506; expenses, $435,638; twelve months' net, $525,868; charges, $354,422; twelve months' surplus, $171,446, as against $219,518 for the preceding year.

SEATTLE ELECTRIC COMPANY.

The Seattle Electric Company, of Seattle, Wash., reports as follows for the month of July and twelve months ended July 31: July gross, $366,481; expenses, $209,950; July net, $156,531; charges and taxes, $87,515; balance, $69,016; sinking fund, $7,344; surplus, $61,672, as compared with $77,205 for the same period of 1907. Twelve months' gross, $4,381,787; expenses, $2,592,139; twelve months' net, $1,789,648; charges and taxes, $944,087; balance, $845,561; sinking fund, $88,451; surplus, $757,110, against $784,517 for the preceding year.

GALVESTON-HOUSTON ELECTRIC COMPANY.

The report of the Galveston-Houston (Tex.) Electric Company for the month of July and twelve months ended July 31, shows as follows: July gross, $93,374; expenses, $52,004; July net, $41,370; charges and taxes, $17,476; balance, $23,894; sinking fund, $2,609; July surplus, $21,285, compared with $26,968 for July, 1907. Twelve months' gross, $1,063,622; expenses, $624,497; twelve months' net, $439,125; charges and taxes, $208,063; balance, $231,062; sinking fund, $31,305; twelve months' surplus, $199,757. This compares with a surplus of $190,796 for the preceding year.

RAILWAYS COMPANY GENERAL.

The Railways Company General (New York) annual report for the fiscal year ended June 30, 1908, is as follows: Total income, $167,071; net profit, $5,679; previous surplus, $280,203; net surplus, $285,882, comparing with $280,203 for the preceding year.

The balance sheet as of June 30, 1908, is as follows: Assets—Cash, $37,874; due from subsidiary companies, $292; bonds of subsidiary companies and capital stock subsidiary companies, $675,754; other securities owned, $155,818; furniture, fixtures and sundry securities, $507; notes receivable, $128,136; total, $998,382. Liabilities—Capital stock, $700,000; accounts receivable, $12,500; net surplus, $285,883.

President T. D. Rhodes says: "While the showing would seem to compare unfavorably with that of previous years the board feels that under the financial conditions prevailing during the period covered, the company is most fortunate in the actual returns made."

TOLEDO RAILWAYS AND LIGHT.

The Toledo (Ohio) Railways and Light Company's report for August and eight months compares as follows: August gross, $212,318; expenses, $113,811; August net, $98,449; other income, $136; total income, $98,585; charges and taxes, $71,879; August surplus, $26,706, comparing with $34,930 for August, 1907. Eight months' gross, $1,641,930; expenses, $907,923; eight months' net, $734,007; other income, $3,011; total income, $737,018; charges and taxes, $563,766; eight months' surplus, $173,252, as against $198,248 for 1907.

NORTHWESTERN ELEVATED RAILROAD.

The Northwestern Elevated Railroad Company's report for the year ended June 30 shows as follows: Gross, $2,463,188; expenses, $965,118; net, $1,498,070; charges, taxes, etc., $1,147,183; surplus, $350,887, which compares with $347,578 in 1907 and $280,499 in 1906, and is equal to seven per cent earned on the $5,000,000 preferred stock. The rate of operating expenses to earnings (excluding loop net earnings) was 50.22 per cent. The ratio of operating expenses, loop account and taxes to earnings (excluding loop net earnings) was 66.64 per cent. President Starring, of the Northwestern Elevated, tells of the satisfactory purchase of forty coaches now in service and twenty combination motor-cars ordered from the Pullman Company for this fall's delivery. The company's total capacity is 28,800 horse-power, or sixty-seven per cent increase. The Ravenswood extension is completed and a satisfactory contract made with the St. Paul, under Chicago and Evanston ordinances, to operate the Evanston division for thirty-seven years. The Sunday business shows big gains. Total passengers carried for the year numbered 37,419,286, a daily average of 102,238. The average daily increase was 17,245, or 20.29 per cent.

Galvanic Battery.

A recent patent, says *Centralblatt für Accumulatoren und Galvanotechnik*, was issued for a galvanic battery in which an increase of capacity and a decrease of internal resistance is attained by replacing the negative electrode by metal shavings placed in closest proximity to the positive electrode. The latter is surrounded in the usual way by a layer of powdered or kerneled material for depolarization. A ring of zinc with a zinc strip, forming the pole, is embedded in zinc shavings. The battery is filled with a solution of NaCl, which furnishes in the chemical process a soluble zinc salt, so that a bright metal surface is always maintained.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Copper Production and Industry in Russia.

The copper production of Russia in the year 1907 amounted to 962,354 poods (one pood being equal to thirty-six pounds) and was greater than that of any preceding year. In 1906 the production was 639,000 poods.

The increase was principally brought about by the mines in the Urals, which almost doubled their output; in fact, from 260,288 poods in 1906 it rose to 436,918 poods in 1907. The next largest producers were the mines in the Altai and Caucasus Mountains and in the Kirghese steppes.

Taking into account the import, the consumption of copper in Russia during 1907 may be estimated as 1,122,000 poods. The price fell continually during the whole year; from twenty-three rubles a pood (for copper ingots) at the beginning of January it descended to fourteen rubles in December.—*Translated and abstracted from L'Elettricista (Rome), August* 1.

Thomshavn to Lokken Electric Railway.

The first single-phase line in Norway, running between Thomshavn and Lokken, is described by A. C. Kelly. The railway is situated about twenty miles west of Trondhjem, from which town a steamer now runs twice daily in connection with the railway. The line runs inland a distance of about seventeen miles. The water-power station is located at Skjenald Fossen. This station supplies power for lighting to Thomshavn and the villages on the line of the railway, to the mining machinery at Lokken, and to the railway itself. The railway load is supplied from a substation at Thomshavn, which contains a motor-generator plant for transforming the 15,000-volt, fifty-cycle, three-phase supply to 6,600-volt, twenty-five-cycle, single-phase current, which is delivered direct to the overhead trolley wire. The Westinghouse single catenary system of trolley suspension is employed, carried on bracket arms on wooden poles. The rolling stock at present consists of three locomotives, one saloon motor-car, four passenger vehicles and twenty-one freight vehicles. Each locomotive weighs twenty tons and carries four motors mounted on two bogies. The high-tension current is collected by a pantograph bow collector mounted on the roof of the locomotive, and passes by an insulated cable to an automatic circuit-breaker, and then to the transformer, which is suspended inside of the cab. The whole of the high-tension apparatus is enclosed in an earthed metal screen. Several tappings are brought out from the low-tension end of the transformer and are connected to the two hand controllers, one at each end of the cab. The four motors are arranged permanently in two groups, with two motors in series in each group. The motors are of the Westinghouse single-phase, series-compensated type, having a rating of forty horse-power for one hour. The pinions have fourteen teeth, and the gear wheels seventy-six teeth, the diameter of the driving wheels being thirty-three inches. The locomotives are capable of exerting a tractive effort of 6,500 pounds at ten miles per hour and a maximum tractive effort at starting of 8,000 pounds. The saloon motor-car, which has been provided for the use of the directors of the company, is a fine specimen of the car-builders' art. It is thirty-nine feet four inches over the headstocks, and eight feet six inches wide at the waist rail, and weighs, in running order, 22.8 tons. The interior is divided into a vestibule and driver's compartment at each end, and two saloon compartments, separated from each other by a short passage, from which a lavatory opens. One saloon compartment is provided with a writing table and swinging arm-chair, and the other is furnished with cross-seats and a central gangway. The body is framed with oak and sheathed with teak. The floor has been made as sound-proof as possible. The body is carried on a substantial underframe of rolled steel which, in turn, is supported by two swing bolster trucks. One of these trucks is equipped with two forty-horse-power motors similar to those used on the locomotives. The interior of the car is upholstered throughout in crimson buffalo hide, the woodwork being of special figured oak. The ceiling is covered with panels of artistic design relieved by narrow gold lines and delicately tinted border. The floor, which is made up of two thicknesses of tongued pine, is covered with felt and cork carpet, on top of which is laid a heavy Axminster carpet. Electric heaters and electric lighting are, of course, provided throughout the car. The car was built by the United Electric Car Company, Limited, of Preston, England.—*Abstracted from the Tramway and Railway World (London), September* 3.

A New Variable-Speed Single-Phase Motor with High Starting Torque.

A modification of the repulsion type of single-phase commutator motor has been developed by H. C. E. Jacoby for fulfiling the requirements where a motor has to have a variable speed, together with a high starting torque. In this motor commutation difficulties are reduced to a minimum by eliminating, in a simple manner, the chief source of commutator troubles inherent with this type of motor. When an ordinary continuous-current winding connected to a commutator is employed in alternating-current work the coil undergoing commutation is in such a position that it encloses the whole magnetic flux, which, being alternating in character, introduces a considerable electromotive force in the short-circuited coil. This electromotive force is out of phase with the main rotor current and causes large surging currents to flow in the coil. Attempts have been made to reduce this short-circuit current by inserting resistances between the windings and commutator bars. In order to obtain sparkless commutation it is necessary that an electromotive force shall be provided in the short-circuited coil of just sufficient value to reverse the current. This is generally done in continuous-current motors by the use of carbon brushes, which, by introducing a gradually increasing contact resistance at the leaving bar, produce a drop of potential across the contact. By a suitable choice of carbons and constants excellent results are secured. In the new motor the rotor winding is so arranged that the coil short-circuited by the brush encloses little or no magnetic flux—that is, it is parallel to the transformer flux. The consequence is that commutation is brought under similar conditions as ob-

tain in continuous-current motors. This is accomplished, furthermore, without complicated connections. The rotor coils are wound across a particular fractional pitch, and the brushes are placed in a position so that the short-circuited coils are parallel to the transformer flux. With this arrangement there are zones on the rotor in which the current flows in opposing directions in adjacent wires. At first sight it would appear that this method of winding would result in considerable loss of torque, and if it were employed on a continuous-current motor the resulting torque with equal currents would be less than half what it would be with an ordinary winding. In this case, however, it is claimed that this mode of winding actually increases the resulting torque. In the first case, by eliminating the heavy currents in the short-circuited coils, a troublesome source of back torque is eliminated. The effects of the currents in the rotor conductors causes a displacement in phase of the magnetic flux in a portion only of the polar face, and to obtain the best results it is necessary that the coils doing motor work should be designed with shortened step to suit this. It is claimed that with this winding equally good commutation is obtained with any brush position between maximum and minimum torque. This makes it possible to govern the speed of the motor by shifting the brush position only. The fact that the friction of the brushes causes the brush rocker to tend to revolve in the direction of rotation makes it necessary to exert only sufficient force to overcome the friction of the brushes, and the slightest deviation from this amount causes the brushes to advance or recede. It is stated that tests taken on a five-horse-power motor at 900 revolutions per minute, on a single-phase circuit, operating at 200 volts, fifty cycles, showed the machine to have a full-load efficiency of eighty-five per cent, and a half-load efficiency of seventy-seven per cent; a power-factor of 0.85, and a starting torque of one pound per 100 volt-amperes at one foot radius.—*Abstracted from Electrical Engineering (London), September* 10.

A Rotary Converter for 2,000 Amperes.

The rotary converter does not enjoy the same favor in Europe as in America; nevertheless it is superior to the motor-generator from the triple point of view of efficiency, expense of maintenance and cost price. On the other hand, it possesses the advantages and disadvantages of synchronous motors without, however, quite equaling the latter in regard to the increase of the power-factor by the over-excitation of the electromagnets. The almost general adoption of a frequency of fifty periods per second in alternating-current lines, which is a little high for a rotary converter, is perhaps the reason for the limited success of these machines. However, in view of the scarcity of actual applications, the details of two identical rotary converters installed recently by the Felten-Guilleaume-Lahmeyer Company in the works of the Chemische Industrie Gesellschaft may be of interest. These two machines, each of 800 kilowatts, have eight poles and a regular velocity of 750 revolutions per minute, which corresponds to a frequency of fifty periods per second. They are fed by three-phase, alternating-current at seventy to eighty volts, and deliver on the direct-current side 2,000 amperes at 110 volts. The movable secondary is 310 millimetres in length and 700 millimetres in diameter. The continuous current is collected by eight rows of six brushes bearing on a commutator 450 millimetres in diameter and 400 millimetres in width, consisting of 168 segments. The position of the brushes is regulated once for all, as the machine works without sparking under all loads. The arrangement for supplying current on the alternating side consists of three copper rings, 100 millimetres wide and 400 millimetres in diameter, on each of which bear nine pairs of brushes. The winding of the secondary is comprised of 168 coils arranged in slots containing four conductors each. The stationary indicator carries eight poles with massive extensions, which are the seat of parasitic currents, having the effect of killing the pendulum movement (pumping) when the converters work in parallel. This construction is simpler and cheaper and just as effective as providing the laminated pole-pieces with compensating windings. It need scarcely be stated that the pole extensions are ventilated in order to prevent overheating. Two cylindrical frames surround the machine completely. Its ventilation and cooling are assured by a ring of vanes fastened on the shaft between the collector rings and the secondary. Fresh air is drawn in at the height of the rings, traverses the converter and is finally blown out over the commutator and brushes. It is well known that, although it is not impossible to start the converter by the alternating current, it is undesirable to do so on account of the heavy flow of current thereby produced, and for this reason an auxiliary asynchronous motor of fifteen horse-power has been arranged at the end of the shaft for starting the machine. It has only six poles, in order to be able to bring the converter to the speed of synchronism in spite of the slip, and is itself started by means of a regulatable resistance in the primary circuit fed by three-phase current at 220 volts from a special transformer.—*Translated and abstracted from L'Electricien (Paris), September* 12.

The Senlecq-Tival Method of Phototelegraphy.

A method of transmitting photographs to a distance has been introduced by Messrs. Senlecq and Tival. This method is distinguished from those of Korn, Carbonelle and Belin by the fact that the actual transmission is a matter of a few seconds instead of thirty or more minutes. The Senlecq-Tival process starts with a bichromate gelatine photograph. This is impregnated with a metallic powder in such a way that the variations of light and shade in the picture correspond with variations in electric resistance of the conducting surface of the picture. A variable resistance is made to cause the current from a constant pressure local battery to vary. These current variations are recorded magnetically on a steel wire, as in a telegraphone. The magnetic record can then be stored away for any desired length of time, and can be employed to reproduce the current variations in a suitable circuit when required. The speed at which the magnetic picture on the steel wire can be transmitted is considerably greater than that at which it can be impressed on the wire in the first case. The receiving instrument consists essentially of a sensitive galvanometer, the deflections of which are magnified by a lever arrangement. The galvanometer actuates a small, thin film screen, which is shaded off from complete opacity to complete transparency by a microphotographic process. In this way the light falling on a rotating disc from a Nernst lamp is varied in intensity in accordance with the deflection of the galvanometer. The disc through which the light passes is perforated with holes lying on a spiral and running from the edge of the disc toward the centre. If the disc in the receiving station rotates synchronously with the telephone drum in the transmitting station, the variations in illumination finally received on a photographic plate correspond with those in the original photograph. It is not stated whether any actual working results have been obtained with this process. It is claimed, however, that if it were possible to reduce the time of transmission to, say, one-tenth of a second, owing to the persistence of vision it would be possible to dispense with the photographic fixing of the received picture, and to view the picture direct on the screen while it was being produced by the rapidly moving spot.—*Abstracted from the Electrical Review (London), September* 7.

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

The Moloney Variable-Voltage Transformer.

The accompanying illustration shows a practical variable-voltage transformer manufactured by the Moloney Electric Company, St. Louis, Mo. This instrument fills a long-felt want in the electrical world, and was designed to meet the demands for a transformer of this kind. The transformer has two rotary dials, one of which increases or decreases the voltage in ten-volt steps. The other dial increases or decreases the voltage in one-volt steps. With this arrangement any voltage from one volt to 150 volts can be secured in one-volt steps.

This type of transformer can be used on the primary (low-tension side) of a high-tension transformer, and will give an increase or decrease of voltage on the high-tension secondary according to the ratio of the high-tension transformer.

MOLONEY VARIABLE-VOLTAGE TRANSFORMER.

This type of variable-voltage transformer is now being used by the largest laboratories in the country, and is a necessary auxiliary to the equipment of every central station using alternating current. It is an almost indispensable aid in properly testing lamps, transformers, meters, cables, etc.

The Columbia Meter.

The Columbia Meter Company, Indianapolis, Ind., has placed on the market an integrating wattmeter, an illustration of which is shown herewith. This meter is of the motor class, being equipped with commutator and brushes. All parts are made by tools, rendering each interchangeable, and giving a light, stiff construction and a good appearance to the meter. The armature is of the open-coil type, having three coils of the same size and shape, symmetrically arranged around the shaft and connected with a three-part commutator. The full current flows through the coils, giving the full effect of the shunt current.

Owing to the small number of commutator segments, a considerable reduction of commutator diameter and brush friction is secured.

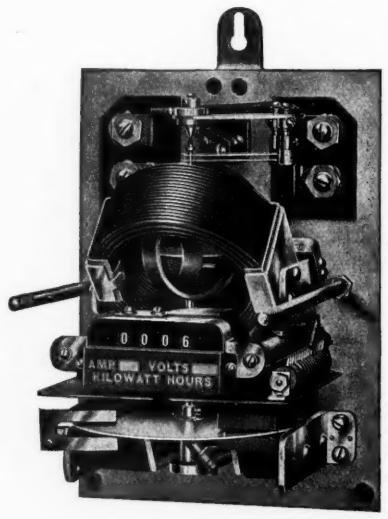
The meter has one series coil, which is placed in an inclined relation with the armature, giving a symmetrical proportion and design. The shunt resistance is a small spool on one side of the meter, easy of inspection and accessible for adjustment or repair. The shunt loss is about two watts at 100 volts.

The two damping magnets are placed at the bottom of the meter, and are interchangeable, and may be taken off and replaced in a few seconds, always going back in the same position. The damping magnets are not moved in calibrating, but a light and easily adjustable armature regulates the damping by shunting more or less of the magnetic flux around the disc. These magnets are protected by a light iron shield between them and the series coil.

The meter is provided with cyclometer counting register, reading in direct kilowatt-hours. The compensating coil is stationary and is regulated by a small rheostat on one side of the meter. The meter has a removable pivot of a grade of steel which experiment has proved to affect the jewel very slightly.

The brushes are of wire, and the brush-holders are easily detachable and in a position for easy inspection and adjustment.

In order that the meter may be sensitive and accurate on low load, it is over-compensated by the compounding coil, made to run fast on low load. If an accuracy of three per cent is desired on fifty watts, the meter is adjusted three per cent fast, thus giving the necessary accuracy as desired. When in service, as the friction increases by long-continued use, the meter will correct itself to a certain extent and show a better agreement between the constants at high and low loads. The adjustment is made by an iron screw, which is magnetized by contact with one of the damping magnets. Three iron studs, fastened to the damping disc, are attracted more or less by the magnetized iron screw. If the screw is adjusted so that a balance is obtained between the rotation of the disc by pressure only, when over-compensated, and the attraction of the magnetized iron screw and studs on the disc is effective, the meter will not rotate, but will start on the smallest load put on it, depending on the adjustment of the screw. This leaves the meter in a very sensitive condition.



TYPE A.B. COLUMBIA METER, HIGH-TORQUE FORM FOR LARGE SIZES ONLY.

With the meter so adjusted, it will run fast on low load, and this over-speed can be made of any percentage by the screw adjustment.

Foreign Trade Opportunities.

The Bureau of Manufactures, Washington, D. C., announces the following foreign trade opportunities:

Bids will be received until November 2, by the Direccion General de los Ferrocarriles del Estado, San Eugenio, Chile, for the supply of three 300-kilowatt generators and other equipment for a 900-kilowatt station.

The Ministry of the Interior, Cairo, Egypt, will receive bids until October 29 for the necessary equipment for the installation of electric light in the town of Zagazig. A guaranty equal to ten per

cent of the amount of the bid will be required.

The Directoria Gerál de Obras e Viação, Rio de Janeiro, Brazil, will receive bids until October 14 for the supply of material and for construction work upon the Oeste de Minas Railway. In addition to the railway construction work there will be the erection of buildings and offices and the installation of the telegraph line, and the supply of machinery, motors, turntables, etc. A deposit will be required with tenders on this project.

A New Twenty-five-Watt Tungsten Lamp.

The accompanying illustration shows the latest addition to the line of tungsten incandescent lamps for standard lighting circuits (100 to 125 volts) that is being placed on the market by the General Electric Company. This is a twenty-five-watt, one to one-and-one-quarter-watts-per-candle lamp made in a practically identical bulb to that used for the ordinary sixteen-candle-power carbon lamp. The illustration shows the exact size of the lamp, which has the same diameter and base and approximately the same length as the familiar sixteen-candle-power unit.

This lamp will burn in any position and its size adapts it for use in any shade or fixture suitable for the sixteen-candle-power carbon lamp. It can be substituted, therefore, lamp for lamp, in all present installations.

At one and one-quarter watts per candle the twenty-five-watt lamp gives twenty candle-power or twenty-five per cent more light than the ordinary sixteen-candle-power lamp. The energy consumed is one-half that of the best sixteen-candle-power carbon lamp and considerably less than one-half the energy consumed by a sixteen-candle-power carbon lamp of similar life—800 hours.

The General Electric Company, as previously announced, has been greatly increasing its manufacturing facilities and is now prepared to manufacture this lamp, together with the forty, sixty, 100 and 250-watt lamps, at the rate of 35,000 lamps total output per day.

Ample stocks of the larger lamps are carried at the main lamp sales office in Harrison, N. J., and at the various local sales offices throughout the country. The stock of the new twenty-five-watt tungsten is at present somewhat limited, but the factory capacity is ample to maintain a reasonable delivery on all ordinary orders.

As the lamp will burn in any position and can be substituted in the regular course of renewals, it will undoubtedly find a large market among isolated plants with the accompanying saving in the coal bill and the opportunity of doubling the number of units and nearly trebling the candle-power with the same equipment.

TWENTY-FIVE-WATT TUNGSTEN LAMP.

It should also be gradually introduced on the circuits of central stations as rapidly as customers can be educated to appreciate its advantages.

Standard Tungsten Low-Voltage Lamps for Battery Service, and Tungsten Miniature Lamps.

The Buckeye Electric Company, Cleveland, Ohio, has developed a line of standard tungsten low-voltage lamps for battery service and tungsten miniature lamps for industrial and decorative service. The advantages of these lamps over the carbon-filament types of miniature and low-voltage lamps are not generally understood. About sixteen types are now standardized and the line is rapidly being increased.

These low-voltage tungsten-filament lamps are peculiarly adaptable to automobile and motor-boat service. They are safer, cleaner, more economical and operate more conveniently than either oil or gas lamps, which have had a monopoly of this field. A number of automobiles equipped with the new lamps have demonstrated that the latter give a large volume of light just where illumination is most needed. They are being used with great satisfaction for headlights, side lights and tail lights. These lamps are operated on ignition storage batteries, on low-tension ignition magnetoes or ignition generators. There is very little cost involved in changing over from the gas lamps or oil lamps to the use of the electric lamps. The lamps are used with special parabolic reflectors, which will give any required distribution.

For automobile and motor-boat work the six-volt lamp is generally the standard. Four-volt and eight-volt lamps are giving satisfaction, and these lamps can be secured in sizes ranging from two to twenty-four candle-power. The lamps operate at approximately one watt per candle.

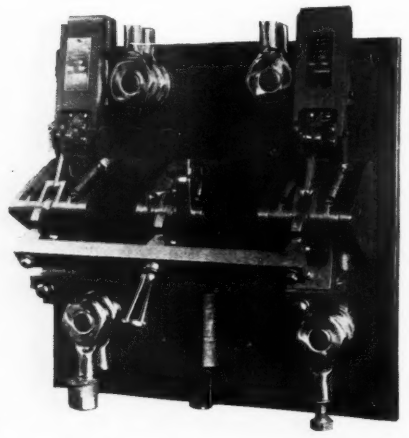
These lamps are also adaptable to train-lighting service, and effect a saving of two-thirds of the current, the best results being obtained with lamps operating on thirty-volt circuits. The breakage is not any greater than that involved with carbon-filament lamps when the thirty-volt sizes are used. Train-lighting lamps are being designed in various types in sizes from twelve to forty-eight candle-power, and in bulbs from one and one-half inches in diameter to three inches in diameter, operating at from one to one and one-quarter watts per candle.

For dental and medical use the low-candle-power miniature tungsten lamps present an entirely new outlook to the operator. It will be hard to secure a better proposition for the dentist or medical practitioner, as these lamps may be operated on dry batteries or small storage batteries, and burn approximately three times as long on a dry battery as a carbon lamp of equal candle-power. The tungsten lamps also operating at lower temperature are decidedly advantageous in dental and medical work.

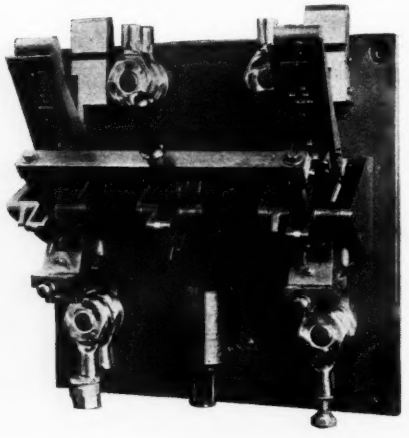
The tungsten miniature lamps, especially in the low-voltage forms, are adaptable to, and will be largely used for, pocket flashlights, for decorative theatrical work, and for Christmas-tree decorations and other novelties.

Special Application of Standard Circuit-Breakers.

In the development of new applications of machinery of various kinds conditions often arise which call for special apparatus or certain applications of old apparatus. Standard apparatus, if properly designed, can be readily adapted to suit these special conditions, with slight changes, and the better the design the more special applications it will fit in on. A notable example of this is shown in a recent application of circuit-breakers, illustrations of which are shown herewith. In this case a large mining company desired a circuit-breaker which would open the circuit of a motor on overload, which could also be opened from a distance by the operator at the machine and which could absolutely be held open by the operator at the machine regardless of the man in charge of the motor. Inasmuch as an absolute interlocking of the machinery was necessary, no chances could be taken of the motor being started when men were working about it.



Circuit-Breaker in Closed Position.



Circuit-Breaker in Open Position.

The illustrations show this breaker in the open and closed positions and illustrate clearly the flexibility of the standard design of the type "CC" circuit-breaker, manufactured by the Westinghouse Electric and Manufacturing Company. This breaker consists of two single-pole breakers and a dummy pole, all closed by the same handle. Each of the single-pole breakers is equipped with an overload coil and the operation of either overload coil opens the breaker, as in the standard type "CC" design. In addition, the breakers can be instantly opened by throwing the handle up. This is a regular feature in the standard design.

In addition to these two overload coils there is placed on the dummy pole a shunt-tripping coil suitable to be left in circuit continuously. Upon closing the circuit through this shunt-closing coil, the middle pole is tripped out and this in turn trips out both of the active poles, thus opening the breaker. In addition to this the handle is locked down by an auxiliary latch in such a way that it can not be closed down until current is taken off the shunt-tripping coil, allowing the core to drop. It is thus impossible for any one to close the circuit-breaker so long as this coil is energized.

In the particular applications small knife-switches were placed at various points, each switch closing the circuit through this shunt-tripping coil. Whenever it is desired to stop the machine and hold it in a stationary position, one of these small switches is thrown in, which immediately opens the breaker and locks it permanently open until the line switch is opened. The breaker is controlled entirely from alternating-current circuits, no direct current being necessary, and it operates large three-phase motors, opening two legs of the three-phase circuit. The breaker is adapted for mounting directly on the wall, the connections being on the face of the panel.

Many other attachments and special applications of this breaker, to satisfy various special requirements, have been developed.

Trigonometric Slide Rule.

M. J. Eichhorn, an electrical engineer, of 5,759 Aberdeen street, Chicago, Ill., has developed a slide rule for solving the various trigonometric functions involved in plane trigonometry. This slide rule is applicable to both the law of cosines and the law of tangents, and other logarithmetrical functions involving the unknown side of a triangle when two sides and the included angle are given.

Two New Pass & Seymour Specialties.

The accompanying illustrations show two new devices placed on the market by Pass & Seymour, Incorporated, Solvay, N. Y. Fig. 1 shows the No. 3010 feed-through switch. This designation comes from the fact that the cord passes through the switch. The uses for such a switch are numerous, as oftentimes in certain work, such as connecting up small sewing-machine motors, stereopticons, heating devices, etc., it is desirable to connect a switch into the cord circuit instead of placing the switch at the end of the cord or using a wall switch. The device is wired by simply passing the cord into the upper bushing, connecting one wire to the terminals, and passing the cord out through the lower bushing. Only one wire is cut, the other passing straight through. This is a National Code device.

Fig. 1.—P. & S. Feed-Through Switch.

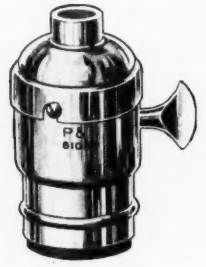


Fig. 2.—P. & S. All-Metal Key Socket.

Fig. 2 shows the No. 460 socket. This is equipped with an all-metal key, the mandrel at all times being "dead." The demand for this socket comes principally from the manufacturers of fixtures, portables and similar devices where it is desired to have a socket with a key to match the finish of the fixture. Any "P. & S." brass-shell socket or receptacle may be equipped with this key, for which a slight additional charge is made.

Current Electrical News

DOMESTIC AND EXPORT.

CAROLINA POWER AND LIGHT COMPANY FILES MORTGAGE—A mortgage from the Carolina Power and Light Company, of North Carolina, to the Standard Trust Company, of New York, has been filed in the office of the clerk of the Superior Court. The board of directors of the Carolina Power and Light Company has authorized the issue of bonds aggregating $5,000,000, payable August 1, 1938, each of said bonds to be of the principal amount of either $500 or $1,000, as the mortgagees may from time to time determine, and all of said bonds to bear interest, payable semi-annually, at the rate of five per cent per annum. This mortgage is signed by John D. Mortimer, vice-president of the Carolina Power and Light Company, and by L. L. Stanton, vice-president of the Standard Trust Company.

LONG ACRE ELECTRIC LIGHT AND POWER COMPANY APPLIES FOR REHEARING OF PRIOR APPLICATION ON STOCK ISSUE—The New York State Public Service Commission has received an application from the Long Acre Electric Light and Power Company for a rehearing on its prior application for permission to issue $10,000,000 preferred stock and $50,000,000 in mortgage bonds which was denied by the commission last June after a series of hearings. The petition for a rehearing is signed by John C. Sheehan and Graham & L'Amoreaux, attorneys for the company. It presents twenty reasons for asking for a rehearing. The last reason is an allegation that the action of the commission is null and void for the reason that the Public Service Commission law was unconstitutional. The commission has taken the matter under advice.

NEVADA-CALIFORNIA POWER COMPANY EXTENDING ITS SYSTEM—By the middle of October the third plant to be installed by the Nevada-California Power Company at Bishop Creek, Nev., will be ready for operation. This third plant has a capacity of 6,000 horse-power, which will make the total capacity of the company 17,000 horse-power. This will be ample for the districts of Bishop, Goldfield, Tonopah, Silver Peak, Millers and Rhyolite. The new mill of the Consolidated Mines Company at Goldfield will require from 700 to 800 horse-power and there are other projects in view which indicate that the company's increased capacity will be fully utilized. Next spring the company expects to equip still another plant with a capacity of 6,000 horse-power, and it is not improbable that the light and power system will be extended into Manhattan, Round Mountain and Hornsilver this fall.

MEXICAN ELECTRICAL NOTES—A contract has been closed by Manuel Cuesta Gallardo, of Guadalajara, with the Siemens-Schuckertwerke, of Berlin, for $7,500,000 of electrical machinery. The contract carries the guarantee of the Mexican Government. This was possible under the new law providing for the payment of subsidies for the irrigation of lands and the establishment of a bank for the encouragement of irrigation works and agricultural development. Mr. Cuesta expects to irrigate from 200,000 to 300,000 hectares of land with water from Lake Chapala. Current is to be supplied to the city of Guadalajara and the properties of the Amparo Mining Company by July, 1909. The first hydroelectric plant will be installed by the Berlin concern near the Totolotlan bridge on the Santiago River, about fifteen miles from Guadalajara, where the necessary hydraulic works have been completed. Two turbines, each of 4,200 horse-power, will be put in. It is estimated that the capacity of this plant can be raised to 11,000 horse-power if desired. As soon as the Totolotlan plant is completed work will be finished on the second hydroelectric plant in the cañon of the Santiago River, some distance above the Las Juntas plant of the Compañia de Tranvias, Luz y Fuerza de Guadalajara. In connection with this installation there will be a canal twenty-four kilometres long, nine metres wide and three metres deep, and a fall of 400 metres, or approximately 1,300 feet, will be secured. It is estimated that it will be possible to generate there at least 60,000 horse-power. According to present plans the plant will be ready for operation within four years. Besides sending current to Guadalajara and using it for irrigation purposes, Mr. Cuesta proposes to transmit current to Aguascalientes and other distant points. There is now demand for several thousand horse-power in Aguascalientes. A concession has been asked for the establishment of an electric plant to be operated by water power about 100 kilometres west of Durango. An English company is said to be back of the move. The object is to furnish light and power to the city of Durango. Mexico City capitalists have formed a company to install a telephone system in Guanajuato. The company has obtained the right to erect poles and already a number of local merchants and others have subscribed for the new service. Puebla is to have a second telephone system. Alejandro M. Azan is organizing a company, to be capitalized at $400,000, to install a new underground telephone system. Application has been made for a concession and, as the new company has the backing of the chamber of commerce, it is believed the concession will be granted within a few weeks. It is hoped to begin construction within two months. A metallic-circuit system will be installed with all wires under ground. In addition to the system in the city of Puebla, the company will construct long-distance lines to Atlixco, Cholulu and Tlaxcala and establish local exchanges in those cities. The company will charge $5 a month for business telephones and $3 a month for residence telephones. It is expected the exchange will begin with 800 telephones in Puebla and 300 in the surrounding towns. The announcement is made by Mr. Azan that he has assurances that the Federal government will construct a long-distance telephone line from Puebla to the City of Mexico. This line, when completed, will be operated by the new telephone company, thirty per cent of the gross receipts being paid to the government for the use of the line.

ELECTRIC RAILWAYS.

EL PASO, TEX.—Citizens have subscribed $45,000 for building an interurban to Valley, thirty miles below this city.

FLINT, MICH.—Work on the extension of the Detroit, Flint & Saginaw electric railway from Frankenmuth to Flint will begin at once.

HOUSTON, TEX.—The Houston Electric Company intends to extend the Harrisburg line of the Houston Street Railroad down the bay shore to La Porte, Seabrook and other points.

NEWARK, N. J.—At an adjourned meeting of the West Orange town council a fifty-year franchise was given the Orange Mountain Traction Company to extend its line across Valley road.

ATTLEBORO, MASS.—The new electric car line connecting this town with Pawtucket and South Attleboro has been opened. This line is to be operated by the Interstate Consolidated Company.

FLORENCE, COL.—Engineers have been investigating the proposed line of electric railway from Turkey Creek through Florence to Cañon City. About seven miles of grading remain to be completed.

NORWAY, MICH.—A project is pending for the construction of an electric railway extending from Norway to the Spread Eagle Lakes, and passing through the village of Quinnesec and the city of Iron Mountain.

AKRON, OHIO—Application to incorporate the Turkeyfoot Traction Company, to connect Turkeyfoot Lake with Akron and Massillon, has been made by Tom L. Childs. The object is to touch the numerous lakes south of Akron.

LAWRENCE, KAN.—The city council has granted a franchise to the Kansas City & Kansas Southwestern Railway Company to

construct an interurban line through Lawrence. The ordinance gives the company ninety days in which to accept the terms of the franchise.

HARRISBURG, ILL.—Promoters are contemplating connecting Eldorado, Harrisburg and Carrier Mills with an electric line. The project is backed, it is said, by the McKinley system, and W. A. Hass, of Lincoln, Ill., is having a preliminary survey of the route made.

JOHNSTOWN, PA.—A plan for the revival of the Johnstown, Ebensburg & Northern Railway project is being considered and likely to culminate shortly. This city and Gallitzin will be the terminal points and the proposed line will be thirty-two miles long and cost $1,200,000.

GOLDFIELD, NEV.—Plans are maturing for a trolley railway system for Goldfield. The directors will include George Wingfield, Denny Sullivan, T. F. Manning and Senator H. V. Moorehouse. The system will cost in the neighborhood of $125,000 and should be completed within a few months.

PHILADELPHIA, PA.—Judge Holland, of the United States Circuit Court, at Philadelphia, has issued a decree appointing John A. Riggs and George Blackenstone receivers of Philadelphia, Bristol & Trenton Street Railway Company. The plaintiffs are the Interstate Railway Company and the United Power and Transportation Company.

RED BLUFF, CAL.—The city trustees of Red Bluff have granted a franchise to the Northern Electric Company for the extension of its lines through the main street of the city. Connecting at Chico with the line now in operation, this extension will open up a rich section of the Sacramento Valley which has heretofore been only partially accessible.

MADISON, WIS.—The state railroad commission has granted the Milwaukee Light, Heat and Traction Company authority to extend its line from Waterford to Lake Geneva. There was no opposition to the request. This grant would indicate that President John I. Beggs is about to further extend the East Troy line and to further tap the Fox River Valley territory.

TACOMA, WASH.—The Tacoma Railway and Power Company has begun work on a new substation at Puyallup. The station will have an initial capacity of 500 horse-power. The building will be of brick, forty-five by fifty-five feet. The new station will furnish power for the operation of the short line through the valley and increase the efficiency of the present line.

SALT LAKE CITY, UTAH—At the session of the board of county commissioners an application for a franchise for the building of an electric line through Ogden Canyon was made by David Eccles and associates. The company asserts its desire to build the line through to the Oaks before winter sets in, and by next summer build on to Huntsville and other Ogden Valley towns.

HUNTSVILLE, ALA.—The transfer of the properties of the Huntsville Railway, Light and Power Company to the Huntsville, Chattanooga and Birmingham Interurban Railway, Light and Power Company has been effected. The new corporation has improvements in prospect, one of the first enterprises being an electric railroad to the top of Monte Sano. Electric power will be secured from the Tennessee River.

CARLISLE, PA.—Several local business men, headed by Willis E. Gladfelter, will apply shortly for a charter to build a trolley line running east along the Harrisburg, Carlisle and Chambersburg turnpike from Carlisle to Balfour, Middlesex township, Cumberland County, a distance of three miles. It is surmised that this road will connect with another running from Carlisle to Carlisle Springs, which is in projection.

UTICA, N. Y.—The stockholders of the Utica & Mohawk Valley Railway Company at their annual meeting elected the following directors: Horace E. Andrews, William K. Vandervilt, Jr., John Carstensen, Edward V. W. Rossiter, William C. Brown, Albert H. Harris, John J. Stanley, Walter N. Kernan, Charles B. Rogers, Nicholas E. Devereux and James S. Sherman. Shares to the number of 75,000 were voted.

MILWAUKEE, WIS.—The lines of the Chicago & Milwaukee Electric road are completed to and including connections in Milwaukee, and it is stated by Clement C. Smith, of the Columbia Construction Company, that cars can be operated on the system at any time. Work on the car barn and substation is well under way, as is the work of stringing wires between Milwaukee and Racine. The car barn is to cost $30,000. The site is 248 feet long and 121 feet wide.

DAYTON, OHIO—The Dayton Street Railway Company has increased its capital from $10,000 to $1,200,000. This company is constructing one of the longest city railway lines in Dayton, the route covering southeastern and northwestern Dayton, as well as traversing the central section of the city. Work of construction is being pushed at both ends, and the road will be ready for operation by the middle of November. It has been financed solely by Daytonians.

LOUISVILLE, KY.—A subcompany of the Evansville & Eastern has been incorporated to build an electric line from Rockport, Ind., east to New Albany, and across the Ohio River to Louisville, Ky. The capital stock is given at $10,000, but it is stated that an amendment will soon be filed increasing it to $1,000,000. The directors include: William H. McCurdy, of Evansville; John C. Haines, Marcus S. Sonntag, Albert F. Karges, William A. Kotch, C. H. Battin and William L. Sonntag.

CHICAGO, ILL.—The work of improvement on several sections of tracks of the Chicago Consolidated Traction Company lines has been authorized by Judge Grosscup before whom the receivership proceedings involving the company are pending. The order was entered in compliance with the petitions of the receivers, David R. Forgan and John M. Roach, who are given authority to use funds from the earnings of the lines or borrowed money. The expenditure will amount to $25,000.

KENDALLVILLE, IND.—Incorporation papers have been filed with the secretary of state by Attorney T. A. Redmond, representing a number of capitalists, for a new interurban line connecting Kendallville and Goshen through Ligonier with branches to Albion and Rome City. The capital is $10,000, which will be increased. A number of Kendallville capitalists are interested, among them being: H. I. Park, president of the Flint & Walling Manufacturing Company, and T. E. McCray, of McCray Refrigerator Company.

SEATTLE, WASH.—Stone & Webster, of Boston, have added to their extensive railway system in the state of Washington by purchasing the Seattle-Everett Interurban, a new electric line projected by Fred E. Sander and associates of Seattle, part of which has already been completed. The purchase price is not made public. It will be consolidated with the Seattle Electric Company, which operates the street electric car lines and the Puget Sound Electric Railway, the interurban line to Tacoma. The line will be extended from Everett to Bellingham, where it will form the north end of a proposed through electric line from Portland to the Canadian border in connection with the Puget Sound Electric road from Seattle.

NEW INCORPORATIONS.

COLUMBUS, OHIO—Lemoyne Telephone Company, Lemoyne. Capital increased to $10,000.

ALBANY, N. Y.—Heuvelton Heat, Light and Power Company. Heuvelton. $25,000. Incorporators: E. L. Thornton, E. F. Thornton, Chicago; A. Thornton, Heuvelton.

COLUMBUS, OHIO—Turkeyfoot Traction Company, Akron. $10,000. Incorporators: Thomas L. Childs, Charles J. Carey, Charles Esselburn, Frank E. Ream and D. W. Ruegsegger.

RICHMOND, VA.—Fredericksburg & Wilderness Telephone Company, Fredericksburg. $1,000 to $5,000. T. F. Morrison, president, Spotsylvania County; R. A. Jennings, vice-president, Orange, Va.; M. W. Thornburn, secretary and treasurer, Spotsylvania County. To operate a telephone line in the counties of Spotsylvania, Orange, Culpeper and Louisa.

SALT LAKE CITY, UTAH—The Monroe Light, Power and Milling Company, of Monroe, Sevier County. $25,000. Officers: John Manson, president; J. H. Erickson, vice-president; Jens N. Jeppson, secretary and treasurer. The concern takes over by purchase fifteen acres of land in Sevier County and other property consisting of an electric light plant and a grist mill.

PERSONAL MENTION.

MR. J. R. WILLIAMS, of Lisbon, Ohio, has assumed the management of the Bell Telephone Company's office at Meadville, Pa.

MR. PLAYER LITTLEFIELD has been appointed manager of the Knoxville office of the East Tennessee Telephone Company.

MR. F. M. HENKEL, assistant manager of the Bryan-Marsh Company, has left that company to open a branch office at 22 Fulton street, New York city, for the Tungstolier Company, of Cleveland.

MR. L. B. MARKS, consulting engineer, and MR. J. E. WOODWELL, recently engineer in the United States Government service, Washington, D. C., announce that they have opened offices in the Terminal Building, 41st street and Park avenue, New York city. Mr. Marks will continue his work in illuminating engineering and Mr. Woodwell will devote himself to power problems.

MR. E. J. KULAS, vice-president and general manager of the Tungstolier Company, of Cleveland, has just returned from a visit to the various Tungstolier branch offices at Boston, New York, Philadelphia, Pittsburg, St. Louis, Chicago, Kansas City, Minneapolis and Denver. On September 26 Mr. Kulas again left Cleveland, and on this trip will go to the Pacific Coast, where he proposes to establish branch offices in San Francisco, Los Angeles and Seattle.

MR. A. P. CRENSHAW, secretary-treasurer of the Chesapeake & Potomac Telephone Company, was the guest of honor at a dinner given in Washington, D. C., last Friday evening, in celebration of his thirty years of continuous service. Mr. Crenshaw was presented with a fine clock and was the recipient also of many personal appreciations from the officials of the company, about twenty-five of whom, from Washington, Baltimore, Philadelphia and New York, were present.

MR. H. H. CUDMORE has been engaged by the Brilliant Electric Company, of Cleveland, Ohio, as general sales manager. Mr. Cudmore has for the past twelve years been identified with electrical jobbing interests in and near Cleveland. As the product of the Brilliant Company is marketed very largely through jobbers, his knowledge and experience in the supply business will enable him to serve such customers to the best advantage. Mr. Cudmore assumed his new duties on September 1, since which date he has been on an extended trip through the East, making the acquaintance of his trade and studying business conditions.

OBITUARY NOTE.

LIEUTENANT THOMAS E. SELFRIDGE, who lost his life in the aeroplane accident at Fort Myer, Virginia, was buried with military honors at Arlington on September 25. Among the honorary pall-bearers were Major G. O. Squier, Lieutenant R. B. Creecy, Lieutenant G. C. Sweet, Dr. Alexander Graham Bell, Professor Octave Chanute, J. A. D. McCurdy, Percy Bradford, Professor Monroe Hopkins, F. W. Baldwin and W. J. Hammer.

NEW MANUFACTURING COMPANIES.

PHILADELPHIA, PA.—Harry V. Haden and Russell Klem, both of Philadelphia, are among the incorporators of the Turbine Equipment Company, of Trenton, N. J., mechanical, electrical, civil and contracting engineers, with a capital of $50,000.

SPRINGFIELD, ILL.—The International Telephone Manufacturing Company has been incorporated to manufacture telephone and telegraph devices with $60,000 capital. The incorporators are: F. M. Burmeister, H. Shafer and J. C. Burmeister, Chicago.

SPRINGFIELD, ILL.—The Arrow Electric Company, of Chicago, with a capital of $2,500, has been incorporated to manufacture and deal in electrical apparatus and appliances. The incorporators are: William M. R. Vose, Hubert E. Page and William C. McNitt.

ELECTRICAL SECURITIES.

The market is now in a fine state of seething excitement trying to follow the fluctuations of the political campaign. The slump of last week was followed by just as big a rally, and the opportunities to make or lose a dollar seem to be about even. Business, it appears, is beginning to show some improvement, entirely without consideration to campaign or stock market conditions. The long season of drought, which threatened ruin to farmers all over the country and imperiled vast forest reserves, appears to have been broken, and reports indicate that there have been heavy rains in every direction.

Dividends have been declared upon the following electrical securities: United Railways of St. Louis; regular quarterly dividend of 1¼ per cent on the preferred stock, payable October 10. Chicago Telephone Company; quarterly dividend of 2 per cent, payable December 31 to stock of record December 23. Previous dividends have been 2½ per cent quarterly. A circular sent to the stockholders also states that a stock dividend of 20 per cent on October 10 will be paid to holders of record October 3. Rochester Street Railway Company; regular quarterly dividend of 1¼ per cent on the preferred stock, payable October 1. Cincinnati & Suburban Bell Telephone Company; quarterly dividend of 2 per cent, payable October 1. Cincinnati Gas and Electric Company; regular quarterly dividend of 1⅛ per cent, payable October 1. Cincinnati Street Railway Company; regular quarterly dividend of 1½ per cent, payable October 1. New York & New Jersey Telephone Company; regular quarterly dividend of 1¾ per cent, payable October 15 to stock of record October 5. Electric Storage Battery Company; quarterly dividends of ¾ of 1 per cent on the common and preferred stocks, payable October 1. Wilkes-Barre Gas and Electric Company; regular quarterly dividend of 1 per cent, payable October 1. Bell Telephone Company of Missouri; regular quarterly dividend of 2 per cent, payable October 1. Central & South American Telegraph Company; regular quarterly dividend of 1½ per cent, payable October 1. Mexican Telegraph Company; quarterly dividend of 2½ per cent, payable October 16. Boston Suburban Electric Company; a dividend of $3 per share, payable in quarterly installments of seventy-five cents, beginning October 15. The first dividend is payable to stock of record October 5. The last previous dividend was at the rate of 3 per cent per annum and was paid October 15, 1907.

ELECTRICAL SECURITIES FOR THE WEEK ENDED SEPTEMBER 26.

New York:	*Closing.*
Allis-Chalmers common	10⅞
Allis-Chalmers preferred	32
Brooklyn Rapid Transit	45⅞
Consolidated Gas	148
General Electric	138⅛
Interborough-Metropolitan common	10⅜
Interborough-Metropolitan preferred	32
Kings County Electric	123
Mackay Companies (Postal Telegraph and Cables) common	67½
Mackay Companies (Postal Telegraph and Cables) preferred	67½
Manhattan Elevated	133
Metropolitan Street Railway	28
New York & New Jersey Telephone	115
Western Union	60
Westinghouse Manufacturing Company	75

Boston:	*Closing.*
American Telephone and Telegraph	129
Edison Electric Illuminating	225
Massachusetts Electric	49
New England Telephone	119½
Western Telephone and Telegraph preferred	75

Philadelphia:	*Closing.*
Electric Company of America	9⅞
Electric Storage Battery common	35
Electric Storage Battery preferred	35
Philadelphia Electric	9¾
Philadelphia Rapid Transit	19¼
United Gas Improvement	86

Chicago:	*Closing.*
Chicago Telephone	146
Commonwealth Edison	107
Metropolitan Elevated preferred	42
National Carbon common	67
National Carbon preferred	108

ELECTRIC LIGHTING.

NEWARK, N. J.—Garfield is discussing the question of a municipal lighting plant.

HATFIELD, PA.—At a special election it was voted to establish an electric light system at a cost of $4,000.

REHOBOTH, DEL.—Rehoboth capital has organized an electric light company and is soliciting subscriptions.

DENVER, COL.—The Denver Gas and Electric Company is having plans prepared for a modern steel office building, six or seven stories in height.

SPRINGFIELD, MASS.—The Williamsburg selectmen have granted pole locations in the village to the Northampton Electric Lighting Company.

HAMILTON, OHIO—Contracts have been awarded by the board of public service for the extension of the lighting system to Lindenwald and East Hamilton.

IRON RIVER, WIS.—The Iron River water, light and power plant was destroyed by fire on September 17. The loss is about $10,000 covered by insurance.

McEWEN, TENN.—L. H. Hopkins has leased the electric light plant and will operate it. The plant heretofore has been running only half the night, but from now on it will be run all night.

CHESTER, PA.—The Spring Lawn water power and thirty-one acres of land near Lewisville, Chester County, have been sold to the Elk River Electric Light, Heat and Power Company for $3,000.

DELEVAN, WIS.—W. H. Tyrrell has been appointed receiver of the Delevan electric light plant in proceedings instituted by bondholders. The company was organized some ten years ago by local capitalists.

JOHNSTOWN, PA.—The city council has awarded a ten-year contract to the Citizens' Light, Heat and Power Company to furnish street arc lamps for $50 each per year, reserving the right to cancel the contract at the end of five years.

MITCHELL, S. D.—The Mitchell Power Company has awarded the contract for the construction of the new electric light plant to the Goetz Construction Company, of Yankton. Work on the building will be commenced as soon as possible.

ALBANY, N. Y.—The Public Service Commission, Second District, has authorized the Mexico Electric Company, of Mexico, Oswego County, to issue $10,000 in bonds to purchase from Edwin L. Huntington, of Mexico, the electric light plant there.

WAYCROSS, GA.—It is reported that George W. Deen, Burdett Loomis and Harley Pettibone will start work at once on an electric light plant for Waycross, and also build a street railway system, extensions of time having been granted on the franchises granted some time ago.

ALBANY, N. Y.—The Public Service Commission, Second District, has authorized the Cataract Power and Conduit Company, of Buffalo, to issue $125,000 five per cent bonds to be secured by a first mortgage dated January 1, 1907. The bonds shall not be sold at less than ninety per cent of par value.

GOSHEN, IND.—Injunction proceedings have been filed against the city of Goshen, Ind., to prevent the rebuilding of the municipal lighting plant at an expense of $45,000. The suit is based on the contention that the municipality is breaking the legal limit of its indebtedness; that the question was not submitted to taxpayers at special election.

MARLBORO, MASS.—According to a statement the Marlboro Electric Company has made a contract with the Connecticut River Power Company to furnish the Marlboro company additional power for use in operating its business in Marlboro, Southboro and Northboro. The power to be furnished by the Connecticut River Power Company will be transmitted to Marlboro from Clinton.

BATH, N. Y.—The Public Service Commission, Second District, has authorized the Citizens Electric Service Company, of Bath, to issue $75,000 bonds and to issue $50,000 common stock. None of the bonds shall be sold for less than eighty-five per cent of their par value. Ground for the company's plant has already been broken. At a meeting Charles I. Davison, village treasurer, was elected treasurer of the company, and S. J. Richard, of Buffalo, vice-president.

PHENIX CITY, ALA.—At a meeting of the Phenix City council an ordinance was read granting a franchise to the Phenix-Girard Power and Lighting Company, a new corporation which proposes to establish a steam plant for furnishing electric light and power. A franchise has already been granted in Girard. The leading spirits in the enterprise are T. W. Butts and B. A. Bass, of Columbus, and I. I. Moses and D. C. Foster, of Girard.

OMAHA, NEB.—An ordinance providing for the construction and purchase of a hydroelectric light and power plant to be owned, maintained and operated by the city of South Omaha, has been introduced in council. The ordinance involves the proposition of the Nebraska Power Company to build a plant for the city. The plant will be built at a cost of $2,500,000. The city will be permitted to pay for the plant in yearly installments out of the proceeds of the sale of light and power. The proposition has met with favor.

ST. LOUIS, MO.—It is announced that the Clayton Electric Company, composed of county capitalists, will push its application for a franchise for furnishing light in the county. The application was filed last spring, but no action was urged on the court. The action of the County Court in granting an extension of territory to electric concerns without any reservation as to the price to be charged has decided the local men, it is said. The Clayton company proposes to furnish current at a price greatly below the figures county consumers are now paying.

BERLIN, MASS.—The franchise granting the Marlboro Electric Light Company the privilege of extending its line from Marlboro to the Clinton line through Berlin, has been signed by the committee appointed by the town. By the terms of the franchise Berlin will have thirty-two electric street lights, to be distributed through the three villages and the intervening streets. They are to be incandescent lamps of forty candle-power. The cost annually will be $17.50 per light. The system is to be put in within six months.

WENATCHEE, WASH.—The Valley Power Company, of Wenatchee, reports that its new power plant will be ready for active operation by October 15. Twelve miles of the transmission line will be completed and the company expects to deliver power to Cashmere and other points along the line. Several pumping plants for irrigation will be installed and will be operated by power from this source. The company expects to extend its line down the Columbia River to Malaga and other points where power will be needed for pumping projects. The company will endeavor to secure a franchise to enter Wenatchee where it will compete with the Wenatchee Electric Company and the proposed Entiat Power Company, now asking for a franchise to enter that city.

DATES AHEAD.

Illuminating Engineering Society. Annual convention, Philadelphia, Pa., October 5-6.

Empire State Gas and Electric Association. Annual meeting, New York city, October 7.

Kansas Gas, Water, Electric Light and Street Railway Association. Annual meeting, Pittsburg, Kan., October 8-9.

American Street and Interurban Railway Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Accountants' Association. Annual convention, Atlantic City, N. J. October 12-16.

American Street and Interurban Railway Claim Agents' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Engineering Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Manufacturers' Association. Annual convention, Atlantic City, N. J., October 12-16.

Railway Signal Association. Annual meeting, Washington, D. C., October 13-15.

Order of the Rejuvenated Sons of Jove. Annual meeting, Buffalo, N. Y., October 15-16.

American Society of Municipal Improvements. Annual meeting, Atlantic City, N. J., October 20-23.

American Electrochemical Society. Fall meeting, New York city, October 30-31.

Association of Car-Lighting Engineers. First annual meeting, Chicago, Ill., November 18.

National Society for the Promotion of Industrial Education. Annual meeting, Atlanta, Ga., November 19-21.

American Roentgen Ray Society. Annual meeting, New York city, December 28-30.

INDUSTRIAL ITEMS.

PASS & SEYMOUR, INC., Solvay, N. Y., has prepared a complete new price list and discount sheet, giving entire revised figures on its entire line. Copies may be had upon request.

THE AMERICAN CIRCULAR LOOM COMPANY, Chelsea, Mass., is distributing a folder combining with its advertising of "Circular Loom," "Electroduct" and "Lutz" metal molding, some data of campaign interest.

THE AUTOMATIC ELECTRIC COMPANY, Chicago, Ill., has published a handsome campaign souvenir in the form of a political atlas, giving a compendium of facts and figures, platforms, biographies and portraits of the men and the issues.

THE SIEMENS & HALSKE A.-G., Berlin-Nonnendamm, has published in English a very interesting catalogue and price list, No. 56, devoted to "Testing Instruments and Accessories." The company is represented in the United States by Dr. Karl Georg Frank, Hudson Terminal Building, 50 Church street, New York city.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., announces that a large contract was signed with the firm of Guinle & Cia., Brazilian agents for the General Electric Company, for the supply of electric energy to the Central Railway of Brazil, which is known as the largest enterprise of its kind in that country, for all purposes, which will include the supply of energy as motive power, as soon as the project now pending for the electrification of a section of that railroad is decided upon. To this firm was also granted a federal concession, covering the supply of light and power to the city of Sao Paulo, which aggregates 300,000 inhabitants, and is known as the largest coffee market in the world.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., has issued the second section of a new series of sectional price lists. This covers the elements, jars and tanks of the "Chloride Accumulator" for electric railway, central lighting and power, isolated lighting, interlocking switch and signal, telephone, telegraph, fire alarm, laboratory, small motor work and miscellaneous service. This price list will be known as Section A and will be followed by other sections covering the many applications of the "Chloride," "Exide" and "Tudor" accumulators. Copies will be forwarded upon application to any of the sales offices of the company. Section C, covering the "Chloride Accumulator" and "Tudor Accumulator" for car-lighting service, was issued in June.

J. G. WHITE & COMPANY, engineers and contractors, 43-49 Exchange place, New York, has begun the surveys for F. H. Buhl, of Sharon, Pa., on one of the largest irrigation projects ever undertaken, contemplating the reclamation of about 700,000 acres of arid land in Southern Idaho. The project is practically an extension of the noted Twin Falls development. Water supply for the proposed extension will be obtained from Snake River. The lands lie to the west of the Twin Falls tract beyond Salmon River and in part beyond Bruneau River. The surveys in progress include reservoir sites, the enlargement of the present Twin Falls Canal, which was developed by Mr. Buhl, to a capacity sufficient to carry the increased water supply, an extension of the main canals to cover the lands of the project, including a syphon to carry the water supply across Salmon River Canyon, which is about 1,650 feet wide and whose bed is 500 feet below the level of the proposed canal. Five surveying parties are already in the field at work on the various parts of the project.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing its 1909 general catalogue, which is a handsome volume of 1,024 pages. Unquestionably, it has been the company's aim to make this catalogue the most complete electrical supply catalogue ever issued, and one needs only to look through the catalogue to be convinced of this. Considerable space is given to the specialties for which the company acts as sales agents, namely, Columbia incandescent lamps, Pittsburgh transformers, Okonite wires and cables, G-L arc lamps and New Lexington high-tension insulators. One is naturally interested also in the extensive line of fixtures which is shown and which naturally gives some conception of the fixture department, which is the most extensive in the West. The special announcement printed on the last page of the catalogue is also interesting as outlining in a general way some of the company's plans for expansion. The company is desirous of placing a copy of this catalogue in the hands of every individual who is actively engaged in plant operations, or who has anything to do with the specifying or purchasing of electrical material.

Record of Electrical Patents.

Week of September 22.

899,024. PARTY-LINE-INDICATING KEY. Clifford C. Bradbury, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. Filed August 3, 1907. The actuating buttons have reciprocating and rotating means for indicating position.

899,068. APPARATUS FOR DETECTING INFLAMMABLE GASES IN AIR. Arnold Philip and Louis J. Steele, Portsmouth, England. Filed September 9, 1907. Means are provided for actuating a visual signal in connection with a catalytic agent.

899,088. GOVERNOR FOR DYNAMOS. Charles L. Weichelt, Philadelphia, Pa. Filed December 11, 1907. The armature is slidably carried on a shaft which is equipped on one end with a coned pulley.

899,127. MEANS FOR PROTECTING HIGH-TENSION OVERHEAD ELECTRIC CONDUCTORS. Lucian Neu, Lille, France. Filed April 3, 1906. Inductive resistances are included in the circuit to shunt certain sections of the circuit.

899,134. ELECTRIC SIGNALING SYSTEM FOR RAILWAYS. Ara P. Rickmire, Waterloo, Iowa. Filed December 30, 1907. Current is supplied through relays and switch points, one rail forming a continuous circuit; and sectional rails are connected to a source of power through the relays.

899,145. ELECTRICAL SYSTEM OF DISTRIBUTION. William A. Turbayne, Lancaster, N. Y., assignor to Gould Storage Battery Company. Filed February 25, 1907. A multi-voltage booster system.

899,153. BLOCK-SIGNAL APPARATUS. Alexander Bevan, Providence, R. I. Filed December 3, 1906. An oscillatory shaft equipped with a target is actuated by an electromagnet.

899,189. ELECTROMOTOR CONTROLLING AND OPERATING SYSTEM FOR ELECTRIC RAILWAYS AND POWER PLANTS. Johann Sahulka, Vienna, Austria-Hungary. Filed June 1, 1907. A two-motor series-control operating system.

899,193. AUTOMATIC ELECTRICAL MEASURING APPARATUS. Daniel J. Shine, Las Vegas, Nev. Filed March 4, 1907. Resistances of relatively large and small quantities are alternately switched into circuit.

899,205. ELECTRIC SWITCH. Charles A. Clark, Hartford, Ct. Filed May 24, 1907. A quick-break snap switch.

899,209. AUTOMATIC TELEGRAPHY. Patrick B. Delany, South Orange, N. J., assignor, by mesne assignments, to the Telepost Company of Maine. Filed December 15, 1896. Means are provided for transmitting signals corresponding to perforations on a tape.

899,220. AUTOMATIC ELECTRIC SAFETY DEVICE FOR BOILERS, ETC. Charles Kausen, New York, N. Y. Filed March 13, 1908. The movement of a plunger actuates a circuit-closing mechanism.

899,226. ELECTROPLATING APPARATUS. George A. Lutz, Plainfield, N. J., assignor to American Circular Loom Company, Portland, Me. Filed June 6, 1908. Means are provided for supporting articles to be plated within a hollow insulating cylinder.

899,234. MASSAGING INSTRUMENT. Julius B. Wantz, Chicago, Ill., assignor to Victor Electric Company, Chicago, Ill. Filed October 23, 1907. A massaging member is actuated by the motor through a universal joint.

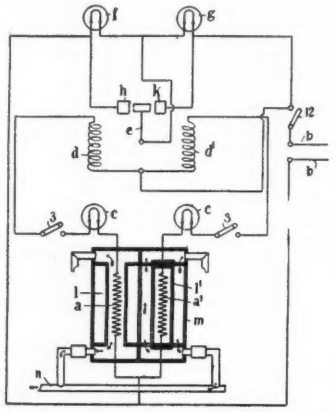
899,239. SIGNALING SYSTEM. Sewall Cabot, Brookline, Mass., assignor to Stone Telegraph and Telephone Company, Boston, Mass. Filed March 10, 1906. A combination of a wireless telegraph system and a wire telegraph system.

899,240. SIGNALING SYSTEM. Sewall Cabot, Brookline, Mass., assignor to Stone Telegraph and Telephone Company, Boston, Mass. Filed March 10, 1906. A combination of a wireless telegraph system and an open-circuit wire telegraph system.

899,241. SIGNALING SYSTEM. Sewall Cabot, Brookline, Mass., assignor to Stone Telegraph and Telephone Company, Boston, Mass. Filed March 10, 1906. An intermediary wire telegraph system is provided with relays adapted to transmit wireless telegraph signals.

899,242. SIGNALING SYSTEM. Sewall Cabot, Brookline, Mass., assignor to Stone Telegraph and Telephone Company, Boston, Mass. Filed March 10, 1906. A combination of a multiplex wireless telegraph system and a multiplex wire telegraph system.

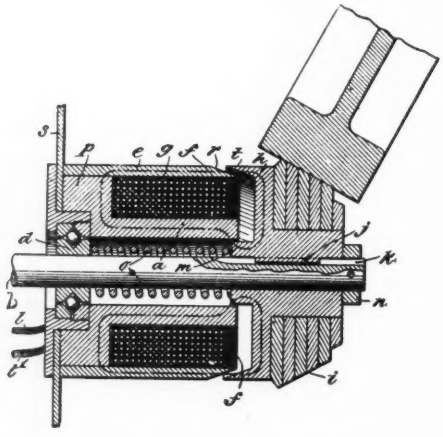
899,243. SPACE TELEGRAPHY. Sewall Cabot, Brookline, Mass., assignor to Stone Telegraph and Telephone Company, Boston, Mass. Filed April 4, 1906. An electromagnetic oscillatory detector.



899,068.—Apparatus for Detecting Inflammable Gases in Air.

899,264. OSCILLATION DETECTOR. Charles E. Russell, Cambridge, Mass., assignor to Stone Telegraph and Telephone Company, Boston, Mass. Filed September 4, 1906. The permeability of the magnetic circuit is varied by the electrical oscillations.

899,272. APPARATUS FOR DETERMINING THE DIRECTION OF SPACE-TELEGRAPH SIGNALS. John S. Stone, Cambridge, Mass., assignor to William W. Swan, trustee, Brookline, Mass. Filed August 17, 1906. The position of the ungrounded elevated conductors is capable of being changed relatively to the direction of motion of the electromagnetic waves.



899,088.—Governor for Dynamos.

899,278. TELEPHONE SWITCHBOARD. Charles E. Wilson, Philadelphia, Pa., assignor to Keystone Telephone Company of Philadelphia, Pa. Filed September 10, 1904. A multiple-position, manually operated switchboard.

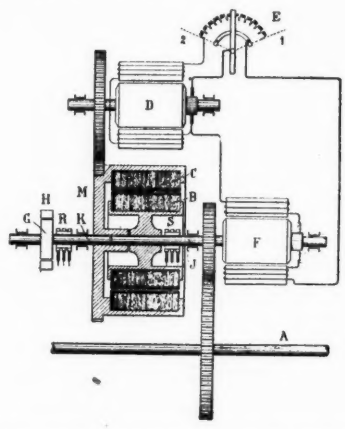
899,307. TELEGRAPH SOUNDER. Lee Kiblinger, Jackson, La. Filed November 18, 1907. Means are provided for equalizing the density of the magnetic field between the armature and different parts of the pole-pieces.

899,348. MAGNETIC ORE-SEPARATOR. Charles E. Stebbins, Iola, Kan. Filed April 17, 1908. A plurality of electromagnets are mounted upon a rotatable spider, a commutator and brushes being provided for supplying current to the magnets.

899,353. ALTERNATING-CURRENT BLOCK-SIGNALING SYSTEM. Jacob B. Struble, Swissvale, Pa., assignor to the Union Switch and Signal Company, Swissvale, Pa. Filed April 1, 1908. Relays are controlled by sectional track circuits controlling the home signals.

899,358. ARRANGEMENT OF PROTECTIVE APPARATUS. Hermon L. Van Valkenburg, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. Filed September 29, 1906. The actuating members of a multiple switch are enclosed in fireproof chambers.

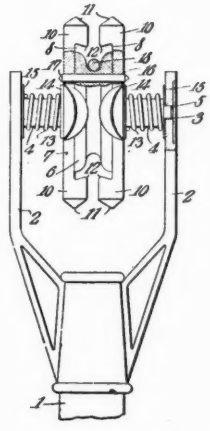
899,364. ELECTRIC SEPARATOR. Henry A. Wentworth, Lynn, Mass., assignor to Huff Electrostatic Separator Company, Boston, Mass. Filed February 3, 1908. The conductive material forms a barrier between the electrodes and is supplied to a rotating cylinder from a hopper.



899,189.—Electromotor Controlling and Operating System for Electric Railways and Power Plants.

899,370. DYNAMOELECTRIC MACHINE OF THE ENCLOSED TYPE. Alfred H. Wouters, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. Filed March 18, 1907. The machine is enclosed in a housing having an air-receiving and an air-admission chamber.

899,379. PARTY-LINE-INDICATING KEY. Clifford C. Bradbury, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. Filed March 11, 1907. The position of the key indicates the last set of switch springs actuated and released.



899,474.—Trolley Wheel.

899,447. DYNAMOELECTRIC MACHINE. Allan B. Field, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. Filed November 30, 1906. A low-resistance ring, independent of the lamina and end plates, is embedded in the pole-piece at right angles to the lamina.

899,474. TROLLEY WHEEL. Joseph W. Seibert, Washington, Pa., assignor of one-half to Elias Lewis, Washington, Pa. Filed February 5, 1908. The trolley wheel is held in position by guide members, and is equipped with openings to lock the parts for a rotary movement.